UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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September 25, 2018

Chinny Esakkiperumal
Olin Corporation
3855 North Ocoee Street
Suite 200
Cleveland, TN 37312

Subject: Notice of Disapproval of:

- Draft Remedial Investigation Report, Operable Unit 3, dated March 30, 2018 ("Draft OU3 RI Report")
- Draft Baseline Human Health Risk Assessment, Operable Unit 3, dated March 30, 2018 ("Draft OU3 BHHRA")
- Draft Operable Unit 1 & Operable Unit 2 Feasibility Study, dated March 30, 2018 ("Draft OU1 and OU2 FS Report")
- Draft Operable Unit 3 Feasibility Study, dated March 30, 2018 ("Draft OU3 FS Report")
- Containment Area Bedrock Boring Results, Olin Chemical Superfund Site (OCSS) in Wilmington MA, dated May 10, 2018
- Revised Rock Matrix Sampling Work Plan (July 6, 2018) and related information provided by Olin/Wood in a letter dated June 29, 2018

(Collectively, the "March 2018 RI/FS Deliverables"), Olin Chemical Superfund Site, Wilmington, Massachusetts ("Site")

Dear Mr. Esakkiperumal,

The U.S. Environmental Protection Agency ("EPA") has received and reviewed the above-listed March 2018 RI/FS Deliverables submitted under the Administrative Order on Consent for Remedial Investigation/Feasibility Study ("RI/FS AOC") for the Olin Chemical Superfund Site ("Site"). Pursuant to Section X, paragraph 40 of the RI/FS AOC, EPA disapproves each of these deliverables for the reasons provided in the enclosed comments (contained in Appendices 1-7), which were prepared in consultation with the Massachusetts Department of Environmental Protection ("MassDEP").

Pursuant to the letter agreement that resolved the dispute regarding EPA's request that Olin develop a range, and conduct an evaluation of, early action source control alternatives (the "Dispute Agreement"), Olin agreed to submit certain RI/FS deliverables by March 31, 2018. EPA has reviewed the March 2018 RI/FS Deliverables, and the data and analyses contained within them, including the Draft OU3 RI supplemental memo titled "Containment Area Bedrock Boring Results" and the "Revised Rock Matrix Sampling Work Plan" (July 6, 2018) and related information provided by Olin/Amec (now Wood) in a letter dated June 29, 2018. EPA has developed extensive comments on these deliverables which are presented in Appendices 1-7. Pursuant to Section 1.III.D of the RI/FS AOC Statement of Work, EPA also solicited and received extensive comments from the stakeholders which are presented in Appendix 8.

Based on EPA's analysis of the data submitted as part of the March 2018 RI/FS Deliverables, and in consideration of the stakeholder comments, EPA has determined[1] that the documents do not contain an accurate and complete Conceptual Site Model ("CSM"). One of the key flaws in the documents is the failure to accurately discuss the impacts of several large uncontrolled sources of contamination, including the DAPL material and the contaminated groundwater in the overburden and shallow bedrock aquifers that continue to migrate uncontrolled. The Draft OU3 RI Report states that the DAPL pools and plumes are "stable," but this conclusion is unsupported by the data. EPA's analysis of the data demonstrates that the contaminated groundwater continues to expand and there are inadequate controls to prevent the continued migration of DAPL into the bedrock and throughout the overburden aquifer. Olin's documents conclude that the bedrock beneath the containment area is competent. EPA's analyses demonstrate that there is an important fracture network beneath the center of the containment area that is likely facilitating the migration of DAPL out of this area (and likely to the northeast where Olin is still evaluating the extent of contamination). Similarly, EPA's analysis of data in the area of the Main Street DAPL pool indicates that there are significant zones of North-west-striking fractures in bedrock that provide the potential for significant contaminant migration pathways not accounted for in the current CSM, numerical model, or, for that matter, the existing monitoring network.

In summary, EPA has concluded that there is sufficient data for the overburden and shallow bedrock aquifers to demonstrate that there are significant, uncontrolled sources that continue to impact the aquifer and the environment. In addition, EPA has concluded that there is sufficient information to proceed with the development of a Feasibility Study to evaluate alternatives that remove or contain these sources from the overburden and shallow bedrock. This conclusion is particularly important given EPA's new understanding of the CSM for the shallow bedrock in both the containment area and the area beneath the Main Street DAPL pool. However, EPA has also concluded that there is insufficient data to support Olin's CSM, the numerical model, and Olin's conclusions regarding the impacts of potential matrix diffusion on restoration of the aquifer. In particular, there are significant data gaps on the nature and extent of fractures in the medium and deeper portions of the bedrock aquifer. These data gaps prevent the development of a complete CSM for the Site and prevent the identification of appropriate locations to sample the bedrock matrix. EPA has provided extensive comments on the data needed to address these critical data gaps.

It is also important to note that EPA has provided information within the attached comments on the extent of work conducted at the other sites cited by Olin to demonstrate a Technical Impracticability (TI) waiver. Based on EPA's experience, these TI waiver demonstrations require extensive data collection coupled with field application of certain techniques to demonstrate

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[1] All references to EPA determinations and conclusions stated in this letter and its Appendices are based upon EPA's review of the current information in the March 2018 RI/FS Deliverables, and do not represent final agency decisions or actions.

and determine what actions are practicable. Consequently, these demonstrations take significant time.

Based on the extensive nature of EPA's comments on the March 2018 RI/FS Deliverables, the time needed to collect additional data to complete the CSM for the Site, the time needed to conduct a proper TI evaluation, and current conditions at the Site, EPA is requiring that the work proceed on two separate tracks and timelines: 1) the development of a FS focused on source control actions, and 2) the development of a workplan to fill the data gaps needed to complete the CSM that is needed to support the development of a FS for the restoration of groundwater and the development of a comprehensive TI evaluation, if Olin chooses to submit such an evaluation.

In response to this disapproval of the March 2018 RI/FS Deliverables, within 60 days of the date of this letter, Olin shall submit a comprehensive response to each comment raised in Appendices 1-7, and shall submit a revised Draft OU3 RI Report and a revised Draft OU3 BHHRA that addresses each of the comments in Appendices 1-5. The revised Draft OU3 BHHRA shall be incorporated into the revised Draft OU3 RI Report (not a separate deliverable). The revised Draft OU3 RI Report shall discuss all sources of contamination including the DAPL and contaminated groundwater that may act as an ongoing source to surface water and sediments and to the rest of the aquifer. The revised Draft OU3 RI Report must also include EPA's CSM for the Site as it is understood based on the currently available data. Within 60 days of the date of this letter, Olin shall also submit a FS Report focused on source control alternatives for OU1, OU2 and OU3 (one FS report, not three separate ones) ("Source Control FS Report"). This Source Control FS Report shall also include alternatives that address other risks posed by soil and sediment at the Site. The Source Control FS Report shall address all applicable comments in Appendices 1, 6 and 7. (Note that by requiring the submission of such focused FS for source control, EPA has not made and is not making a final decision that source control is appropriate.)

As discussed above, significant data gaps exist in the medium and deep regions of the bedrock network across the Site, and a workplan is required to address these deficiencies. Olin shall submit a workplan that provides a comprehensive approach to address all of the data gaps identified in comments contained in Appendices 1-5, within 90 days of the date of this letter.

The Appendices are as follows:

- Appendix 1 – EPA comments on Draft RI Report, OU3, March 30, 2018
- Appendix 2 – EPA comments on Containment Area Boring Results, May 10, 2018
- Appendix 3 – EPA comments on Appendix H, Numerical Modeling, March 30, 2018
- Appendix 4 – EPA comments on Revised Rock Matrix Sampling Work Plan, July 6, 2018
- Appendix 5 – EPA comments on Draft Human Health Risk Assessment for OU3, March 30, 2018
- Appendix 6 – EPA comments on Draft Feasibility Study for OU1/OU2, March 30, 2018
- Appendix 7 – EPA comments on Draft Feasibility Study for OU3, March 30, 2018
- Appendix 8 – Original Stakeholder Comment Letters

Due to the extensive revisions that are necessary to address the comments in the Appendices of this letter, EPA reserves the right to provide additional comments on the modified RI/FS deliverables submitted in accordance with this letter.

Please feel free to call me at 617-918-1247 if you have any questions. For legal questions, please contact Kevin Pechulis at 617-918-1612.

Sincerely,

James M. DiLorenzo
Remedial Project Manager
USEPA Region 1 - New England

cc: Lynne Jennings, EPA
Kevin Pechulis, EPA
John Kilborn, EPA
Garry Waldeck, MassDEP
James Cashwell, Olin
Lisa Funderburg, Esq., Olin
Kimberly Portnoy, Esq., Stepan Company
David M. Amidon, Esq., Biltrite Corporation

APPENDIX 1

EPA Comments on Draft Remedial Investigation Report, Operable Unit 3 (March 30, 2018)
Olin Chemical Superfund Site, Wilmington, Massachusetts

GENERAL COMMENTS

1. EPA has completed a comprehensive review of Draft OU3 RI Report ("RI Report" or "Report") including the data supplied in the Report and the Appendices. Based on this review, EPA has concluded that this RI Report does not include an accurate Conceptual Site Model ("CSM") for the Site. In numerous comments below, EPA identifies the issues with Olin's CSM and requires that the Report be revised to incorporate EPA's analysis of the data and a revised CSM. One of the key flaws in the Report is the failure to characterize and discuss the impacts of several large uncontrolled sources of contamination including the DAPL material and the contaminated groundwater in the overburden and shallow bedrock aquifers that continue to migrate uncontrolled. The Report states these sources are "stable." These conclusions are unsupported by the data. The few actions that have been taken to contain or control these sources have not been successful, and the source materials continue to migrate uncontrolled and are therefore not "stable." The Report shall be revised to delete these statements and include EPA's CSM for the Site that there are uncontrolled sources posing a risk to the aquifer and the environment.

2. APPENDIX 2 of this letter contains EPA's comments on the investigation within the containment area to assess the competency of the bedrock beneath the containment area. For the technical reasons provided in the analyses contained in APPENDIX 2, EPA rejects the conclusions of this study. The design of this study was unilaterally developed by Olin and its consultant, Wood, in the absence of regulatory input and/or *in conflict with* previously supplied comments and suggestions. The study and its conclusions are critically flawed. APPENDIX 2 contains EPA's independent analysis of the bedrock information available for this area. Based on this analysis, EPA maintains that the bedrock beneath the containment area is not competent and that fracture connectivity between the sub-containment area bedrock and known and/or undiscovered fractures likely exists. The RI Report shall be revised to include the analysis and conclusions provided by EPA in APPENDIX 2. Furthermore, while the comments in APPENDIX 2 provide requirements for additional work, this work would refine EPA's conceptual site model, not demonstrate the competency of the bedrock. Olin shall provide a comprehensive response to the comments in APPENDIX 2 and revise the RI Report accordingly. In addition, as discussed in comment 5 below, Olin shall also submit a work plan to address the data gaps noted in Appendix 2.

3. APPENDIX 3 of this letter contains EPA's comments on *Appendix H, Numerical Modeling, Draft Remedial Investigation Report, Operable Unit 3, Olin Chemical Superfund Site, Wilmington, MA.* For the technical reasons provided in the analyses contained in APPENDIX 3, EPA concludes that the Conceptual Numerical Model is constrained by a general lack of data regarding the nature and extent of the bedrock fracture network beneath the study area. EPA concludes that these data gaps must be addressed to develop a valid Conceptual Numerical Model. Olin shall provide a comprehensive response to each comment raised in APPENDIX 3 and revise the RI Report and

Appendix H accordingly. In addition, as discussed in comment 5 below, Olin shall also submit a work plan to address the data gaps noted in Appendix 3.

4. APPENDIX 4 of this letter contains EPA's comments on the *Revised Rock Matrix Sampling Work Plan (July 6, 2018) and related information provided by Olin/Wood in a letter dated June 29, 2018.* For the technical reasons provided in the analyses contained in APPENDIX 4, EPA disapproves the Revised Rock Matrix Sampling Work Plan on the basis that the single test borehole proposed by Olin is located in an area of known fractures and likely micro-fractures. Results of testing in this proposed borehole would likely yield results that are more representative of groundwater conditions than the rock matrix. For a matrix test to be valid, Olin must demonstrate that the zones to be sampled are free of visible and micro-fractures. Olin shall provide a comprehensive response to each comment raised in APPENDIX 4. In addition, as discussed in comment 6 below, Olin shall also submit a revised work plan to address the data gaps noted in Appendix 4.

5. In addition to the issues with the CSM for the containment area which are summarized in General Comment 2 above, EPA also has numerous and significant comments on Olin's CSM for the areas down gradient, particularly the Main Street DAPL pool area. EPA's evaluation and mapping of the available data demonstrates a very different CSM. The details of this evaluation are presented in comments contained in Appendix 3 and 4. In addition, a summary presentation along with figures is attached as Appendix 1- Attachment 1. In summary, EPA has concluded that a well interconnected set of fractures appears to exist in Main Street DAPL pool area. This interconnected fracture network combined with the shape of the top of rock (TOR) surface in this area provides a variety of migration pathways from the DAPL area to the low-lying wetland and stream areas to the northwest. This Main Street "spill way" appears to be the dominant controlling hydrogeologic feature which influences both density driven and contaminant migration as well as groundwater flow in both the overburden and bedrock. EPA's analysis and conclusion must be included in the revised RI Report. In addition, this analysis and conclusion shall be included in the workplan, as discussed in comment 6 below, and considered in the plan to collect the data necessary to evaluate this conclusion more fully.

6. EPA has concluded that there is insufficient data to support Olin's conclusions regarding the CSM for the bedrock aquifer and the impacts of matrix diffusion on the long-term remedy for the Site. A comprehensive work plan is needed to address these data gaps. It is also important to note (as noted in the attached comments) that as with the work conducted at other sites to demonstrate the technical impracticability of certain goals (like restoration to drinking water standards), the required data collection, if Olin chooses to submit a Technical Impracticability Waiver Evaluation Report, requires several ongoing and iterative steps that will take significant time to design and implement. Such a demonstration also requires a robust demonstration that adequate actions have been taken to control the source. Based on the extensive nature of EPA's comments, the time needed to collect additional data to complete the CSM for the Site, the time needed to conduct a proper Technical Impracticability (TI) Evaluation, and current conditions at the Site, EPA is requiring that the work proceed on two separate tracks and timelines: 1) the development of a feasibility study ("FS") focused on source control actions

("Source Control FS"), and 2) the development of a workplan to begin the process of filling the data gaps needed to complete the CSM which would support the development of a FS for the restoration of groundwater ("Further Groundwater Response Action FS" or "Further Groundwater FS") and the development of a comprehensive TI Evaluation, if Olin chooses to submit such an evaluation.

7. Olin shall submit a workplan that provides a comprehensive approach to address all data gaps identified in comments contained in Appendices 2-6 within 90 days from receipt of this letter. Olin shall also submit the Revised RI Report within 60 days from receipt of this letter. As noted in numerous comments below, EPA is requiring that the Revised RI be updated to include data, maps and figures that are necessary to support the scoping of this new work. The Revised RI shall note that additional investigations are planned and that the RI Report will be supplemented with addendums as needed to document the new findings.

8. Based on EPA's review and analysis of all the data submitted to date, EPA has determined that the data strongly supports the need for the development of a FS with robust source control alternatives. The Draft OU3 Baseline HHRA documents that the DAPL pools and diffuse groundwater areas provide an unacceptable exposure risk, and EPA has determined that these areas remain an active source of contamination to the broader aquifers. Therefore, source control alternatives shall be developed which address at a minimum: 1) any source material present within the OU1 and OU2 study areas, 2) the OU3 waste within the containment area, including the DAPL and other highly contaminated groundwater in both the overburden and shallow bedrock aquifers within the containment area, 3) the DAPL and other highly contaminated groundwater located in downgradient areas from the Olin Property including Jewel Drive and Main Street, and 4) any groundwater that may be migrating to impact the surface waters and sediments associated with the Site. Additional data is not needed for the development and finalization of the Source Control FS.

9. APPENDIX 5 of this letter contains EPA's comments on the *Draft OU3 Baseline Human Health Risk Assessment (March 30, 2018)* ("BHRRA"). For the reasons provided in APPENDIX 5, EPA disapproves the BHHRA on the basis that it fails to include a future exposure pathway that evaluates groundwater within the Aberjona watershed as a potential potable source. Olin shall provide a comprehensive response to each comment raised in APPENDIX 5 and revise the BHHRA and the RI Report accordingly. The revised Draft OU3 BHHRA shall be incorporated into the revised Draft OU3 RI Report (not a separate deliverable).

10. The RI Report is formatted in a manner such that relevant Site characteristics and extent of contamination information is presented separately for the Aberjona and Ipswich River watersheds. EPA acknowledges that the study area contains both watersheds, but presenting the information in this fractured manner is often confusing and suggests that groundwater does not interact between the watersheds. To the contrary, EPA concludes that the watersheds are hydraulically connected through a network of shallow bedrock fractures. EPA notes that groundwater contamination from the primary release area on the Olin Property in the Aberjona watershed (Lake Poly and former lagoons) is detected in the Maple Meadow Brook (MMB) area,

which is in the Ipswich River watershed. Olin explains this as the result of DAPL that migrated independent of overlying groundwater, as a separate aqueous phase liquid, gravimetrically along the bedrock surface, and as diffusive mass transport continuing to impact MMB groundwater. This CSM is incomplete as it shall also be noted that contaminant transport across watershed divides may continue to occur in groundwater via fracture networks. Olin's previous CSM (prior to 2016) did not recognize any movement of DAPL or dissolved-phased contaminants into bedrock. Olin's more recent CSM, which is not included in the Report but was submitted previously as Figure ES-5, acknowledges that significant contamination in the form of DAPL and diffuse groundwater has migrated into the shallow bedrock fractures beneath MMB. As noted in comments on Appendix 2, there is evidence of shallow dipping fractures within the containment area in recently installed borings OC-BB-1-2108 and OC-BB-2-2108. The CSM shall include the possibility of groundwater movement from the containment area in the Aberjona watershed through the fractured bedrock network making contributions to contaminant transport into the Ipswich River watershed. Also, during the period when Olin and its predecessors were operating at the Site, an active municipal well field was present in MMB consisting of 5 deep overburden wells. These municipal wells reportedly extracted more than 2 million gallons per day. This well field was located only about 2,500 feet from the former lagoon and manufacturing areas. EPA has determined that this amount of strain on the aquifer could have resulted in the movement of overburden groundwater containing Site contaminants across the watershed boundary. This scenario would explain the elevated concentrations of TMPs measured in MMB deep overburden and bedrock monitoring wells as shown in Figures 4.4-3.2b and 3.2c (i.e., GW-83D and MP-5#03). TMPs were part of a separate release in the Plant B area of the Site and are not associated with the DAPL release. The CSM shall be expanded to include the migration of source materials from the former manufacturing and lagoon/Lake Poly areas to the MMB area due to: (1) influence on the overburden/deep overburden aquifer from the then active municipal well field; and (2) through the shallow bedrock fracture network which continues to connect the two areas.

The CSM also fails to explain the source of diffuse groundwater in the MMB aquifer. Figure 4.4.1-1b displays the extent of diffuse groundwater located within the deep overburden of the study area. There is a diffuse plume which is clearly associated with the containment area, Jewel Drive and Main Street DAPL pools. This is explained in the current CSM by the ongoing chemical diffusion of Site contaminants from DAPL to overlying groundwater. However, there is also a large broad diffuse plume mapped within the MMB aquifer. While there is empirical evidence of DAPL in shallow bedrock monitoring well GW-83D, no DAPL pool has been mapped in the MMB aquifer. The occurrence of a diffuse plume in the absence of a DAPL pool in the MMB aquifer provides strong evidence that a significant DAPL source remains within the shallow bedrock fractures within the MMB aquifer. The CSM shall be expanded to explain the formation of this large diffuse plume in the MMB aquifer. In summary, the RI Report shall be revised to include all aspects of the CSM as presented in this comment and all other comments provided.

11. There are several sections in the Report where evaluations are incomplete and conclusions are not supported with data. Much of the Report attempts to rest on previously submitted documents, several dating back prior to the remedial investigation itself. The RI Report is intended to be a standalone document. Where information in previous reports is relevant to the nature and extent of groundwater contamination, the RI Report shall provide an updated

comprehensive summary of the data and analysis. In our comment letter dated December 7, 2017, EPA previously identified a number of these issues and most of these comments were not adequately addressed in the Report. EPA has noted those issues again and the Report shall be corrected accordingly.

12. The specific gravity and chemistry statistics used to determine the definitions of DAPL and diffuse groundwater shall be re-evaluated based on the updated samples from the RI. Now that it has been more than 20 years from the initial evaluation and Olin has a substantial new data set, the original assumptions shall be validated to ensure that they are still correct. Further refinement of the term "DAPL" shall include ranges of all key parameters and characteristics of what is considered "DAPL," and what is not considered DAPL. This re-evaluation shall be presented in the RI Report so that it can be reviewed as part of the CSM and approved if EPA agrees with the evaluation.

13. Synoptic water level rounds: Wells have been installed after the 2011 synoptic water level rounds were completed. The additional bedrock wells and wells installed outside of the Olin property have the potential to provide new insight into groundwater flow and contaminant migration. Some limited water level rounds have been conducted since 2011, and these results shall be discussed and figures included in the Report. In addition, a future synoptic water level round (as described in the 3rd paragraph of Section 2.2.3) shall be planned to incorporate as many monitoring wells, piezometers, and surface water points as possible to provide a complete evaluation of groundwater contours.

14. The data from the private water supply sampling shall be included either as its own appendix or as part of Appendix E of the Report.

15. Certain Report sections appear to be contradictory or repeated in separate areas (e.g., both Section 4.2 and 5.1 describe contaminant sources and present data in slightly different ways, leaving the reader to attempt to parse out the most accurate and complete version). The Report shall be revised accordingly.

16. In the discussion of Bedrock Geology and Structure (Section 3.2.3), the Report shall include and appropriately reference a figure depicting Olin's understanding of the bedrock lithology and regional fault structures. Figure 3.2-1 of the FRI (MACTEC, 2007) (updated to include observations from more recent borehole geophysics work) may be used for this purpose.

17. Section 5: The discussion of DAPL and groundwater interaction in the Draft OU3 FS Report (AMEC, 2018, Section 1.4.4) has more details regarding bedrock and DAPL migration than Section 5.2 of the RI Report. The Report shall include these details (degree of weathering and location of weathered zones, migration of DAPL, and migration of diffuse groundwater) in Section 5.

18. The bedrock topography is a critical evaluation in terms of DAPL migration and groundwater contamination. Another subsection shall be added to Section 3.2.3 that focuses on bedrock topography. This subsection shall include:
    a. the discussion contained in the last two paragraphs currently found in Section 3.2.3;
    b. additional cross sections to demonstrate any conclusions discussed; and
    c. an evaluation of the competence of the bedrock surface in general and specifically in

the areas where DAPL has been identified. Note that borehole geophysics frequently begins below a casing which has been grouted into rock; therefore, boring logs and other indirect measurements of surface competence may need to be used for evaluation.

19. Figures 2.1-1 and 2.1-2, 2.2-1 through 2.2-6, 2.2-10, 3.3-1 and 3.3-2, 3.6-1, and all Section 4 figures contain a thick purple line depicting the Ipswich and Aberjona watershed boundary. Is the source of this boundary the MassDEP watershed delineation, or is it based on Olin's RI work? The figure legends shall be updated with the source information.

20. Several tables listed in the Table of Contents are not included in the RI. Additionally, some tables included in the Report are not included in the Table of Contents. Tables 4.1-1 through 4.3-1 as listed in the Table of Contents do not exist in the Report. Table 4.3-1 does exist in the Report but is not the same as what is reported in the contents. Tables 4.4-9 and 4.4-10 are not listed in the Table of Contents. These missing tables shall be provided and the table of contents shall be updated accordingly.

21. A well construction table including all monitoring wells and multi-level ports shall be included in the RI Report. The table shall include the construction details and current status for all known wells within the study area, including those no longer present. This information has been provided in the past, but has not been provided in an updated form to include all wells installed to date. This information is critical to evaluate subsurface data.

22. Several documents cited (such as the MACTEC Focused Remedial Investigation [MACTEC, 2007]) are not included in the reference list. All cited documents shall be included in Section 8.0.

23. Some figures refer to the Boston Harbor Drainage Basin (Figures 1.2-1 and 3.1-2) while the text refers to the Aberjona watershed. For clarity, the Report shall be consistent in its use of the names of the drainage basins.

24. Given the Site history, the RI Report shall include a discussion of the possibility of Per- and polyfluoroalkyl substances (PFAS) on the Site. A workplan shall be submitted by Olin to determine whether PFAS contamination is present at the Site as part of the overall workplan that shall be submitted pursuant to comment 5 above.

SPECIFIC COMMENTS

1. Page ES-1, 3rd paragraph: EPA disagrees with the statement that the two watersheds have a "fundamentally different potential for future potable use of groundwater." Active use of groundwater currently occurs within each watershed. There is no restriction on future use of groundwater within either watershed, except for the voluntary restriction placed on use of groundwater beneath Olin's own property. The Massachusetts Department of Environmental Protection ("MassDEP") has designated groundwater throughout the entire study area, that is groundwater within both the Ipswich and Aberjona watersheds, to be of "High" Use and Value. The statement cited above in the Report is not supported by the facts and shall be deleted and replaced with discussion that explains that MassDEP has classified the aquifer as a "high use and value" aquifer and has requested that the risks posed to current and future users of the aquifer be assessed.

2. Page ES-1, 4th paragraph: The last sentence states "the actual origin of NDMA has not been identified." Site data shows a pattern of elevated concentrations of NDMA within the densest portions of the plume (commonly referred to as the DAPL pools). This pattern of data clearly demonstrates that the NDMA was released to the aquifers concurrent with the documented manufacturing chemicals such as ammonia, sulfate and chloride. Whether the NDMA was used in the former manufacturing process, or was created either during the manufacturing process or in-situ from pre-cursor chemical compounds discharged during the manufacturing process has no bearing on the current nature and extent of NDMA in groundwater as delineated by the existing data-set. This statement is not supported by the facts and shall be removed.

3. Page ES-2, 3rd and 4th bullets. These activities are outside the scope of the approved RI/FS Work Plan and are currently under separate review.

4. Page ES-3, 2nd paragraph. This paragraph discusses the development of a "conceptual level numerical model" used to evaluate the fate and transport of NDMA in bedrock. The paragraph then states that the model predicts that the restoration of bedrock groundwater will "take over several hundred years" which makes restoration of bedrock groundwater an "unrealistic expectation and likely to be technically infeasible." Olin had never proposed the use of a numeric model during the RI. The model itself was not presented or discussed anywhere in the RI/FS Work Plan (8/14/2009). Any model used by Olin shall be presented for EPA's review and approval. Until EPA approves the model, its input parameters and its purpose, the information in this paragraph is considered by EPA to be speculation and shall be removed. See separate Appendix H comments.

5. Page 1-2, Section 1.1, 2nd bullet. States that a Report objective is to determine current groundwater flow directions and gradients. Since the RI Report includes some evaluation of the previous (pumping) flow regime, the objective shall be revised to state that the objective is to determine <u>historical and current</u> flow directions and gradients.

6. Page 1-2, Section 1.1, 3rd bullet. Indicates that one objective of the RI Report is to assess surface water and groundwater interactions by measuring the gradients. The assessment of surface water and groundwater interactions should not be limited to gradient measurements. The text "by measuring the gradient between shallow groundwater and surface water at specific locations" shall be deleted. Additional potential evaluations shall include comparison of contaminant and groundwater chemistry and identification of potential confining units such as fine-grained sediment.

7. Page 1-2, Section 1.1, 4th bullet. Indicates that the objective of the bedrock evaluation in the RI Report is to assess groundwater quality surrounding the DAPL pools near Eames Street, Main Street, Jewel Drive, and Cook Avenue. The bedrock evaluation shall include all areas where bedrock contamination may be reasonably suspected, which includes any areas of known bedrock contamination, bedrock located beneath elevated concentrations in the deep overburden, and areas downgradient of or along fracture sets emanating from known areas of bedrock contamination. The Report shall be revised and the evaluation corrected.

8. Page 1-3, Section 1.2, first sentence. The text shall be revised to state that the Site includes the areas described in addition to wherever contamination from Property manufacturing and waste

disposal practices has come to be located.

9. Page 1-3, Section 1.2, second paragraph, second sentence. The text refers to process waters and wastes that were discharged to unlined excavations. These locations shall be described (e.g., the former Lake Poly and others) and a reference to these locations on a figure (such as Figure 1.3-2) shall be added.

10. Page 1-3, last paragraph. Near the end of this paragraph which continues onto p. 1-4, the text states that "the DAPL and groundwater that immediately overlies the DAPL [referred to elsewhere as diffuse groundwater] also contain low level concentrations of VOCs and SVOCs." TCE and Bis-2-ethylhexlphathalate both exceed the federal MCL. While there is no federal or state MCL for NDMA, the concentration of NDMA frequently exceeds the tap water RSL of 11 ng/l. Since the definition of "low" is subjective, these statements shall be revised and replaced with factual statements that indicate how the concentrations compare to MCLs, other ARAR cleanup goals, and risk-based standards.

11. Page 1-4, Section 1.2, third paragraph. The Report shall clarify which chemical manufacturing buildings are referred to, and add a reference to a figure showing the buildings. Figure 1.3-2 shows the various buildings associated with Olin operations, but does not refer to a group of chemical manufacturing buildings per se.

12. Page 1-6, Section 1.3, third paragraph, second sentence. The statement refers to an Environmental and Open Space Restriction "described above", but the restriction is not mentioned before the statement. A reference to (can be to a later section) or discussion of this restriction shall be added to the Report.

13. Page 1-6, Section 1.3, fifth paragraph. A reference to a figure depicting the on-property and off-property water bodies described, such as Figure 1.3-1, shall be added to the Report.

14. Page 1-8, Section 1.3.2, third paragraph, last sentence. Section 2.1.2.2.2 of the FRI (MACTEC, 2008) does not have any additional information not included in this section; this reference shall be omitted and the Report shall retain only the reference to the original C-RAM status report (GEI, 2004).

15. Page 1-8, Section 1.3.2, 4th paragraph (and Section 2.1.1.1, 4th paragraph). These paragraphs describe the slurry wall equalization window, which allows free movement of shallow groundwater in and out of the containment structure. Given that waste was retained in place for slurry wall construction and that a DAPL pool is present in this area, it is likely that contamination will diffuse upward and re-contaminate the shallow groundwater that passes into and out of the equalization window. The Report shall discuss potential mass flux from the equalization window. Note that this mass flux was calculated within the "Semi-Annual Analysis of Post-Construction Monitoring Plan Data" report included as an appendix to the Construction RAM status report 8 (GEI, 2004).

16. Page 1-9, Section 1.3.4. The Report shall show the 20 acres of the Environmental and Open Space Restriction on a figure and refer to it in this subsection.

17. Page 1-9, Section 1.3.6: The East Ditch (both the upper and lower sections) shall be added to

this subsection. These ditches may be an important component to evaluate contaminant fate and transport in shallow groundwater north of the Olin property where the NDMA plume was encountered.

18. Page 1-10, DAPL: Several comments on the "DAPL" equation/definition. The equations shall be updated to determine if it is still accurate for defining DAPL. The base equation/definition is as follows:

    The definition of DAPL is based on having a specific gravity greater than 1.025 which can be estimated by an empirical relationship of its primary constituents, and by threshold concentrations, as follows:
    - *Ammonia concentration greater than 1,250 milligrams per liter (mg/L);*
    - *Chloride concentration greater than 2,800 mg/L;*
    - *Magnesium concentration greater than 270 mg/L;*
    - *Sodium concentration greater than 1,700 mg/L;*
    - *Sulfate concentration greater than 16,000 mg/L; and*
    - *Specific conductance greater than 20,600 micro-ohms per centimeter (µmhos/cm).*

    The equation for Specific Gravity (SG) is:
    SG = 2.6 x 10-7 x SO42- + 1.3 x 10-6 x Na+ + 3.7 x 10-6 x Cl- + 7.4 x 10-7 x NH3 + 1.01

    Comments:
    a. This analysis was completed in 1999 by Geomega. It shall be updated using the data collected since then to see if the analysis is still a reasonable predictor. For example, Olin uses Specific Conductance greater than 20,600 umhos/cm to determine the top of the DAPL. The Report shall confirm that this is still an accurate figure. Include an updated analysis in the revised Report.
    b. The equation indicates that the Specific Gravity would increase with an increase in ammonia, however, ammonia has a density less than 1, and an increase in ammonia will decrease, not increase SG. The equation shall be corrected to reflect this issue.
    c. The Report states that NDMA concentrations in DAPL overlap with those found in overlying diffuse groundwater and therefore the concentration is not a reliable indicator of DAPL. This analysis shall be included in the revised Report.
    d. WERC suspects SG of 1.025 was selected to define the DAPL because marine water has an SG of 1.025. A different SG could have been selected, such as 1.01 and a thicker "DAPL" would be defined. Include detailed analysis of the selection of 1.025 and why this represented a "statistically distinguishable population compared to the groundwater samples from diffuse/ambient groundwater" (p. 2-13) in the revised Report.
    e. A better definition/equation of "DAPL" would include pH. pH controls the "plugging" by precipitates of the soil and is a key parameter for pumping the DAPL. The Report shall provide the relationship between pH on the 'DAPL' parameters in the revised Report.
    f. Vertical profiles of each parameter in the "DAPL" shall be provided in the Report. Profiles shall include, where available, bedrock, "DAPL", Diffuse Layer" and the remainder of the groundwater.

19. Page 1-11, Section 1.3.7, 1st paragraph. This text states "DAPL also contains low and trace concentrations of other metals, TMPs, SVOCs (mostly phthalates) and NDMA with maximum

historical detected concentrations up to 64 ug/L (64,000 nanograms per liter [ng/L]).” Consistent with the earlier comment, Bis-2-ethylhexlphathalate exceeded its MCL 17 known times. The maximum historical detected concentration of NDMA is nearly 6,000 times higher than the tap water RSL of 11 ng/l. Consistent with previous comments, statements that describe contamination as low shall be replaced with factual statements comparing the concentrations to MCLs, other ARAR cleanup goals, or risk-based standards.

20. Page 1-11, Section 1.3.7, 2nd paragraph: The Report shall refer to a figure that shows both the DAPL pools and their names as provided in the text, such as Figure 1.3-4. Figure 1.3-4 does not include an “Upper DAPL Pool.” If this feature is used to describe the combined Off-Property and On-Property DAPL pools, it shall also be shown on a figure. If this term is used solely to describe the DAPL pools that are higher in elevation, recommend not capitalizing “Upper” and making it clear at the beginning of the second paragraph that the upper DAPL pool includes two pools.

21. Page 1-11, Section 1.3.7, 2nd paragraph. The text states “The majority of existing dissolved phase contaminants in groundwater resulted from convective mixing during initial migration of the DAPL while the facility was being operated. The mass flux of dissolved constituents through the diffuse layer is likely small in comparison to those initial releases from convective mixing.” This assertion is not supported by any data in this section and shall be evaluated in the discussion of fate and transport. This statement shall be omitted from this section.

22. Page 1-11, Section 1.3.7, 3rd paragraph. The text indicates the presence of DAPL in weathered bedrock at well GW-43D. However, this well is not included within the area of the Off-PWD DAPL pool. The extent of the DAPL pool shown on the various figures shall be modified to include this location or the Report shall explain why this well is not included in the DAPL area.

23. Page 1-11, Section 1.3.7, 5th paragraph. The text states that “The 20,600 µmhos/cm value was statistically derived by previous investigators as a threshold value…” A reference to the specific document that developed the DAPL threshold concentrations shall be provided and the Report shall include a summary of this evaluation.

24. Page 1-11, Section 1.3.7, 5th paragraph. The Report states that “NDMA concentrations in DAPL overlap with those found in overlying diffuse groundwater and therefore the concentration is not a reliable indicator of DAPL.” The Report shall provide the analysis that supports this statement.
25. Page 1-11, Section 1.3.7, 6th paragraph. The Report states that “diffusion results in the presence of a “Diffuse Layer” which is a three to five-foot thick layer of groundwater that overlies the DAPL, and is defined by specific conductance between 20,600 and 3,000 µmhos/cm.” The Report shall provide support why 3,000 µmhos/cm was selected as the top of the “Diffuse Layer”. Vertical profiles of the parameters shall be added as noted in previous comments. Diffusion of NDMA and ammonia, highly mobile parameters, has occurred well beyond 3-5 feet defined by the “diffuse Layer.” Olin shall clarify in the Report that the term “Diffuse Layer” is limited to selected parameters and doesn’t include NDMA and ammonia. The Report shall also include concentration contour maps for each of the contaminants of concern, including NDMA and ammonia, and these contours shall be compared to the boundaries of the DAPL material and the “Diffuse Layer” on new figures added to the report.

26. Page 1-12, Section 1.3.8. The Report shall add a reference to a figure showing the watershed divides.

27. Page 1-12, Section 1.3.8, Watershed Divide. The Report states the location of the current watershed divide but fails to include a discussion of the data available when the municipal wells were pumping and discuss the location of the watershed divide when the municipal wells are pumping. A review of the historical data indicates that the water shed divide was likely located on the Site when the municipal wells were pumping. This information explains why most of the contamination is in the Ipswich watershed and not the Aberjona watershed. The figure the Interim Update Investigations, Smith, June 1996 provided information on the divide from October 1995. Additionally, the report titled "Olin Wilmington Technical Series XIV. A Groundwater Flow and Solute Transport Model April 2001 by Geomega" provided the groundwater information on the divide for April 1998. The revised RI Report shall include figures and information from these reports and discuss the impacts of the location of the divide on the extent of contamination.

28. Page 1-14, Section 1.4.2.2, 3rd paragraph. The Report shall clarify whether the Tank 7 of the Plant B treatment system is the same as the Tank 7 that was part of the Plant B Tank Farm.

29. Page 1-16, Section 1.4.2.3, 3rd paragraph. Lake Poly has been identified as a primary source area and is of interest for the RI. The text notes that Lake Poly has been the subject of several investigations, as documented in the FRI (MACTEC, 2007), the OU1/OU2 RI (AMEC Foster Wheeler, 2015b), and in several MassDEP submittals. The Report shall provide references to the primary MassDEP submittals where this information can be found. The Report shall also include a detailed summary of the data and the conclusions from those investigations. The summary shall demonstrate with data the remaining contamination in these areas at the conclusion of the previous cleanup and whether the concentrations that remain pose a leaching threat to groundwater.

30. Page 1-16, last paragraph. Text states that 4,350 cy of soil were excavated, and 200 cy of soil were disposed. The Report shall describe in detail what happened to the remaining 4,150 cy of excavated soil.

31. Page 1-17, Section 1.4.2.4. This section shall have a more complete discussion of the sewer and septic systems, as leaking piping may have been a significant source of contamination in addition to the various disposal lagoons and pits. The section refers to more detailed discussion from the OU1/OU2 RI (Amec Foster Wheeler, 2015b), but the details specifically pertinent to potential groundwater sources shall be added to the Report. These include piping schematics, description of piping construction (to the extent known), and a reference to a figure showing these features. Known or suspected leaks in process sewer lines (described in the last sentence of Section 1.4.2.3, 5th paragraph) shall also be included in this discussion.

32. Page 1-17, Section 1.4.2.4. States that additional description of the sanitary and septic systems at the facility are provided in the FRI (MACTEC, 2007) and the final OU1/OU2 RI Report (Amec Foster Wheeler, 2015b). Upon review of these documents, the descriptions of these systems are essentially the same. The Report shall only use one reference (such as the OU1/OU2 RI report) for clarity.

33. Page 2-5, Section 2.1.1.1, 7th paragraph. The statement. "…and subsequent responses to comments indicated that the slurry wall is functioning as intended and designed." EPA does not agree with this statement and it shall be deleted from the Report. The slurry wall was designed and constructed without EPA involvement. The goals of the intended design are unknown and not approved by EPA. The degree of containment achieved by the slurry wall is unclear. Groundwater monitoring data outside and just downgradient of the slurry wall indicate increasing concentrations in at least one downgradient well cluster (GW-202) which suggests that the slurry wall is not providing sufficient containment. An evaluation of water level measurements indicates that the slurry wall is not preventing groundwater flow into and out of the containment area. Groundwater flow is not limited to the equalization window as intended in the design. Rather, groundwater flow remains consistent with that outside of the slurry wall which demonstrates that the slurry wall is not providing sufficient containment (see detailed comments on the Draft OU1/OU2 FS Report). Furthermore, the Hydraulic Pulse Interference Test (HPIT) which was intended to assess the effectiveness of the slurry wall was inconclusive and found to not be a representative test for the unconfined aquifer conditions. The Report shall conclude that there are uncertainties associated with the effectiveness of the slurry wall at containing the source areas located on the Olin property. The Report shall also note that the wall does not extend beyond the property boundary and is therefore not effective at controlling the source areas located off the property.

34. Page 2-13, Section 2.1.2.10, 4th paragraph. The reference to Section 1.3.2 is not correct. The reference shall be revised to Section 1.3.7.

35. Page 2-20, Section 2.2.3. The text indicates that Table 2.2-2 lists wells proposed to be included in May and October 2011 synoptic water level rounds and a rationale for wells proposed but not measured. There does not appear to be any indication in Table 2.2-2 as to which wells were not monitored or why they were not monitored. Table 2.2-2 shall be updated to include this information.

36. Page 2-21, Section 2.2.2, 8th paragraph. In the last sentence, "after discussion with USEPA" shall be deleted.

37. Page 2-23, Section 2.2.4, 5th paragraph. This section mentions clogging of the second lowest port in one of the multi-level monitoring wells. EPA was not aware of any clogging during the tests. The Report shall provide supporting data.

38. Page 2-23, Section 2.2.4, last paragraph. The RI Report shall include all performance monitoring and volume data collected during the voluntary operation of the DAPL extraction system (November 2015 through June 2018.)

39. Page 2-23, Section 2.2.4, last paragraph. Olin was, until recently, operating the Pilot well at 0.25 gpm, stating operating issues when operating at 0.5 gpm. The Report shall provide the data and other information collected during operation that lead to the conclusion to reduce the pumping rate to 0.25 gpm, and subsequently to suspend operation at 0.25 gpm.

40. Page 2-24, Section 2.2.5, 3rd paragraph. The Report states: The HPIT Final Evaluation report (Amec Foster Wheeler, 2016) that included GeoSierra's Phase II HPIT Report concluded that: 1)

A very consistent and stable hydrogeologic condition exists that is dominated by the presence of a vertical hydraulic barrier (e.g., the slurry wall) that diverts groundwater around the Containment Area, and isolates the groundwater within, and 2) that the slurry wall associated with the Containment Area continues to serve its intended purpose and be structurally sound. These statements are not true and shall be deleted from the Report. The conclusion from the HPIT Final Evaluation report was that HPIT could not determine the adequacy of the slurry wall. Additionally, page 5 of the HPIT Final Evaluation report states that "the results of test well pair GW-6D to GW-CA3D deserves additional discussion." This statement supports the fact that there may be another plausible explanation for the data. EPA believes that the pressure pulse observed between these two wells was likely transmitted under the wall rather than through it especially considering that the slurry wall is not keyed into the bedrock. This conclusion is further supported by an evaluation of the water surface elevation data collected inside the containment area since 2013. An evaluation of this data indicates that the outside water surface elevations have a significant influence on the interior water surface elevations. This indicates that flow is occurring into and out of the containment area either through the slurry wall, through the slurry wall/bedrock interface, through weathered bedrock under the slurry wall, or through bedrock fractures. The Report shall be revised to include this analysis and shall conclude that there is considerable uncertainty associated with the effectiveness of the slurry wall at containing contamination in this area.

41. Page 2-24, Section 2.2.5, 3rd paragraph. The statement "The USEPA accepted Olin's recommendation of no further testing related to the slurry wall" shall be deleted from the Report.

42. Page 2-24, Section 2.2.7, 2nd paragraph. The Report shall include the total number of private wells sampled since 2008.

43. Page 3-3, Section 3.2.1, 2nd paragraph. The text states that discussion of the shallow overburden materials (concrete slabs, fill, organic/peat deposits) have been omitted because they have no bearing on OU3. This statement is incorrect. The extent and rate of recharge to the subsurface (and therefore both groundwater and contamination flow) is controlled by the relative permeability of the shallow overburden materials. In addition, near surface organic deposits may serve as important sinks for contamination that may be carried downward with recharge from precipitation. Discussion of the shallow overburden materials and how they may inhibit or enhance recharge and therefore groundwater flow patterns shall be added to the Report.

44. Page 3-5, Section 3.2.2, 2nd and 3rd paragraphs. EPA had requested a north-south cross-section to evaluate potential source areas. The cross-section provided is focused on the immediate vicinity of the former Lake Poly and reproduces a figure originally provided in the OU1/OU2 RI (Figure 3.2-2). The Report shall address the soils, bedrock, and potential groundwater pathways from the Lake Poly source area to the DAPL pools. The other cross-section lines provided are perpendicular and significantly west of this area. The Report shall include the following to evaluate the groundwater conditions associated with the original source area and to evaluate groundwater conditions in the areas of high NDMA concentrations north and southeast of the Olin property (see attached mark-up):

    a. Extend cross-section A-A' to the north to incorporate data from the GW-400 cluster.
    b. Extend cross-section A-A' to the southeast to incorporate the upper DAPL pools and

the following wells (in order from the current southern end of the cross-section): GW76S, GW-CA1/GW-CA2/GW-36, MP-1, GW-79S/PZ-16RR, PZ-18, GW-50S/D, and GW-49D/GW-80BR/D/S.

c. Extend cross-section B-B' to the east to incorporate data from the GW-413 cluster.

d. Extend the Lake Poly cross-section to the north to incorporate data from GW-302, GW-301, GW-31S/D, the GW-413 cluster, and GW-415D (from south to north). If a borehole is installed to the west of the GW-413 cluster, this may replace that cluster.

e. Extend the Lake Poly cross-section to the south to incorporate DAPL pool information, including the following (from north to south): GW-35S/D, GW-30DR/PW-2, GW202S/D/BRS/BRD, and GW-39.

45. Page, 3-10, Section 3.3. The Report shall calculate and tabulate groundwater flow rates based on representative hydraulic conductivities and gradients at multiple depths and in different areas of the Site, taking into account the ranges of geologic material encountered, and include this information in the text or in a table as appropriate. If site-specific hydraulic conductivities are not available, the Report shall explain the reasoning for selecting representative values. This information is critical to evaluate potential contaminant migration rates.

46. Page, 3-13, Section 3.4. The discussion of bedrock hydrogeology shall be expanded to include the following topics:
    a. Discussion of hydraulic conductivities measured in bedrock in different areas (not just a single borehole). Note that Table 3.3-2 lists hydraulic conductivity values for MW202BR, MW-203BR, MW-204BR, and MW-206BR.
    b. Calculation of an estimated range of bulk (large-scale) groundwater flow rates based on gradients and hydraulic conductivities.
    c. Evaluation of the potential for fracture interconnection and groundwater transport. While bedrock groundwater flow is through individual fractures, several bedrock boreholes have extremely large fractures and fractured zones. The Report shall discuss the implications of these significantly fractured zones.
    d. Presence and thickness of a weathered bedrock zone at the top of bedrock.
    e. The elevation differences between bedrock boreholes do not suggest that groundwater will necessarily flow from high to low head, because bedrock groundwater flow is generally restricted to fractures. However, they do indicate potential for groundwater flow, and on a sufficiently large scale, may be appropriate to indicate groundwater flow. The Report shall include bedrock groundwater contour maps and discuss the potential for bedrock groundwater flow, and how the fracture regime may impact this potential for flow.
    f. Evaluation of the potential for groundwater flow in bedrock near the bedrock DAPL pools and other areas of DAPL.
    g. Section 5.2, 1st paragraph suggests that bedrock flow directions mimic deep overburden groundwater flow because the two systems are connected. Where competent bedrock exists, the systems may not be connected to a significant degree. The discussion of bedrock flow shall address the potential connection between aquifers.
    h. The Report shall discuss the expected fracture regime in the vicinity of Cook Ave, and describe both the quantity and quality of hydrogeologic data available to determine the potential bedrock migration pathways in this area.

47. Page, 3-13, Section 3.5. Maple Meadow Brook and Sawmill Brook. This section shall be revised

to include a discussion of the potential impacts of shallow groundwater on both Brooks. While most of the shallow groundwater samples in the Maple Meadow Brook Watershed (MMBW) have been non-detect for NDMA, elevated concentrations of NDMA in shallow groundwater have been detected at GW-83S, GW-82S, and potentially upgradient (GW-58S). The limited NDMA data from GW-83S also indicates that concentrations have increased over time. This shallow groundwater has the potential to migrate upward and impact the MMBW, and therefore the surface water bodies associated with it. The Report shall be revised to include a comprehensive discussion of these potential impacts.

48. Page 3-16, Section 3.6, 4th paragraph. The statement "Overall, the cessation of pumping from the municipal wells had no major impact on the groundwater divide observed near the site" is not supported by data in the Report. The Report shall include data and figures that demonstrate this conclusion. The data and figures shall include water level measurements taken before and after the use of these wells and shall include figures showing the location of the divide based on these measurements. All available data, including data from October 1995, shall be included in the analysis. In addition, rather than including a subjective statement like "major," the Report shall just reference the figures as a demonstration of the magnitude of the impact.

49. Page, 3-16, Section 3.7. This section shall discuss MassDEP's Groundwater Use and Value determination for the Site as prepared in September 2010. The Report shall discuss the results of MassDEP's evaluation and the regulatory context of the groundwater use and value process with regard to evaluating potential groundwater use at a CERCLA site. The Report shall note that as part of the use and value determination, MassDEP requested that groundwater risks, including human health risk associated with active and potential drinking water of the Site groundwater, be evaluated. Section 6.0 of the RI Report shall be corrected to summarize the requested risk assessment.

50. Page 3-5, Section 3.2.2, and Page 3-7, Section 3.2.3. The Report shall include a note indicating the vertical exaggeration on the cross-sections included on Figures 3.2-5 and 3.2-6.

51. Page 3-10, Section 3.3. There is an absence of data with which to fully evaluate groundwater flow in the vicinity of the Site. Potentiometric maps are included for the May and October 2011 synoptic water level rounds; however, numerous monitoring wells were not included in these rounds (as indicated by the "NG" in Table 3.3-1). Some of the wells not gauged in 2011 were included in a December 3, 2015 synoptic water level round; however, potentiometric maps of the 2015 data are not included. The Report shall include potentiometric maps of the 2015 water level data for shallow overburden, deep overburden and bedrock monitoring wells.

52. The Report shall include hydrographs of water level data for all locations. Data from wells within a cluster shall be plotted on a single hydrograph so that vertical hydraulic gradients over time can be evaluated. The Report shall include water level data collected when the public water supply wells were active as well as more recent data.

53. The Report shall include figure(s) posting the vertical hydraulic gradient at each well cluster, include gradients between shallow and deep overburden, and between deep overburden and bedrock, at a minimum.

54. The Report shall include potentiometric cross-sections and expand the discussion of vertical hydraulic gradients, particularly focusing on areas near DAPL. The Report shall include potentiometric maps that represent conditions that existed when the public water supply wells were pumping.

55. Table 3.3-5 is a summary of vertical hydraulic gradients but it does not include any bedrock monitoring wells. This table shall be expanded to include, at a minimum, all well clusters with bedrock monitoring wells. Vertical hydraulic gradients shall be calculated for multiple monitoring dates so that average gradients can be calculated and changes over time can be evaluated. The Report shall include water level data collected when the public water supply wells were active, as well as more recent data.

56. Sections 3.7 and 4.1 of the RI Report discuss groundwater use classifications. The Report shall be revised to, at a minimum, include figures showing the location of these areas relative to the Site. The Report shall also be revised to add figure(s) showing these areas relative to the groundwater contamination.

57. Page 4-1, Section 4.1. The second paragraph in this section shall be deleted from the Report. This section shall summarize MassDEP's Groundwater Use and Value determination for the Site as prepared in September 2010.

58. Page 4-1, Section 4.1.2. The references to the MCP's definitions of "Current Drinking Water Source Area," "Potential Drinking Water Source Area," and "Potentially Productive Aquifer" shall be deleted from the Report.

59. Page, 4-2, Section 4.1.3. The reference to the MCP's definition of "Non-Potential Drinking Water Source Area" shall be deleted from the Report. The referenced sections of the MCP are not ARARs under CERCLA and refer to the potential to develop public water supply distribution systems. It does not prevent the potential installation of private water supply wells within the portions of the Aberjona watershed that are within the Site study area. The Report shall be corrected by deleting or revising the language to make it factually correct.

60. Page 4-4, Section 4.2.3. Although NDMA formation could not be replicated in a lab setting, the Report shall identify possible sources of NDMA. The Report shall also discuss any trends in the concentration of NDMA over time in the aquifer.

61. Page 4-4, Section 4.2.3, Location and volume of DAPL. The Report discusses the location and volume estimates of the DAPL pools, but the Report does not appear to include supporting data. The Report shall explain how the DAPL pools were delineated and include the monitoring data used to delineate them. The Report shall explain how the DAPL volumes were estimated, and include the calculations and data used to estimate the DAPL volumes.

62. Page, 4-4, Section 4.3.1. This section requires additional detail. Specifically, the Report shall include a list of the wells included in the RI/FS work plan that were to be sampled, but were not sampled and why (i.e., not located, located but damaged, or located but dry). Also, this section shall describe the sampling and results for 1,4-dioxane conducted according to the approved workplan.

63. Page, 4-5, Section 4.3.2. This section shall provide the final list of contaminants of concern for discussion of contaminant nature and extent. This section shall also describe the selection criteria for selecting contaminants of concern based on exceedances of screening criteria and frequency of detection. While Section 4.3.2 does describe fuel-related compounds and chlorinated solvents as being related to other properties, it does not list the specific compounds that are screened out based on this evaluation, which it shall be revised to do. For comparison, we have highlighted potential contaminants of interest based on frequency of detection and exceedances of MCLs/SMCLs or residential tap water RSLs if MCL/SMCLs were not available (see table in Appendix 1 - Attachment 2). The text shall be revised accordingly.

64. Page, 4-6, Section 4.4. The data depictions in the Section 4.4 contaminant maps are based on a statistical comparison to the results for each figure. Therefore, it is difficult to compare figures for different depths for the same contaminant. For example, the maximum sulfate concentration in deep overburden is almost an order of magnitude above that of bedrock and the TMP1P maximum concentration in shallow overburden is more than an order of magnitude above that of bedrock. The Report shall be revised to use the same symbol weighting for all three depths for a given contaminant to facilitate comparison.

65. Page, 4-6, Section 4.4. In addition to the listed contaminants of concern (“COCs”), dibenz(a,h)anthracene exceeds the tap water RSL in more than 5% of samples analyzed. PAHs have also been identified at concentrations above background in OU1 soils. The Report shall be revised to add contaminant distribution maps for PAHs (or a single representative PAH) and add a discussion of their distribution.

66. Page, 4-6, Section 4.4, 1st paragraph. This paragraph shall be revised to state that the target analyte list was greatly expanded under the CERCLA program to address compounds identified as COCs under CERCLA guidance. The text shall also state that the RI included two rounds of data collection from each available well. In addition, the text shall state that additional rounds of data were also collected from a sub-set of the wells which are used to monitor Plant B, the containment area and the DAPL pilot under the IRSWP. The Report shall be revised to reflect this work.

67. Page 4-6, Section 4.4, 5th paragraph. In the informal comments provided on the Focused RI Report, as well as in the technical meetings conducted this past fall and winter, EPA clarified its expectation that iso-contour figures (more commonly referred to as “plume maps”) shall be presented in the Report to display the extent of NDMA and other key parameters in groundwater. The Report shall be revised to include plume maps (with concentration contours) for each COC for shallow, deep overburden, shallow bedrock and deep bedrock.

68. Page 4-7, Section 4.4.1. Based on a review of Figures 4.4.1-1a/b/c, it is not clear how the boundary of potential impacts on the east side of the Site was determined. Figure 4.4.1-1b showing deep overburden groundwater has wells along the east side of the site (GW-32D, GW-52D, GW-307, GW-3D, GW-51D, GW-4D, GW-50D and GW-80D) with detections of NDMA ranging from 22 to 1300 ng/l of NDMA. Figure 4.4.1-1c showing bedrock groundwater only has two bedrock wells on the east side, GW-413BR and GW-80BR, which have concentrations around 130 and 97 respectively. The “Extent of Impacts” boundary is drawn along the property line on the east side of the property. However, there are no wells on the east side with non-detects of NDMA to indicate that the line is correct. Also, for bedrock wells, Figure 4.4.1-1c, the

"Extent of Impacts" boundary for NDMA shall be extended to include the private wells that have had detects of NDMA. The Report shall be revised to show the proper boundaries for the extent of contamination. If data is lacking to complete the figures correctly, this issue shall be noted in the Report.

69. Section 4.4. The Report shall be revised to indicate the time period the data used to generate the Figure 4.4 series (showing nature and extent of contamination) covers. The Report shall indicate what data, if any, are excluded. Figure 4.4.1-1c indicates NDMA detection in approximately half of the groundwater samples collected in the vicinity of the Mill Brook Country Day School. The Report shall provide the data and discuss concentration trends.

70. Page 4-7, Section 4.4. It is unclear how Olin selected the criteria for "low", "moderate" and "elevated." These adjectives are subjective and don't provide an accurate factual context to the data. For example, for NDMA, Olin defines the "low" range as 0.42 to 31 ng/l. The upper end of this range is well above the tap water RSL of 11 ng/l. The statements using these terms shall be deleted from the Report and replaced with a discussion of how the data compares to MCLs, RSLs, or risk-based standards.

71. Page 4-7, Section 4.4. COCs. Neither the BHHRA nor the RI Report discuss the specifics of each of the COCs including NDMA. The Report, and the BHHRA, shall be revised to include a summary of the physical and chemical properties, as well as MCLs, other ARAR cleanup goals, or risk-based standards for all COCs.

72. Page 4-30, Section 4.4.5. Even though a particular metal is naturally present in an aquifer matrix, if Site-related contamination caused a geochemical change allowing for increased dissolution in groundwater, these metals must be addressed in groundwater. The Report shall be revised to include such metals as COCs.

73. Page 4-34, Section 4.4.5.3. The text states that hexavalent chromium was detected inconsistently and that these concentrations are considered false positives. However, the hexavalent chromium was consistently encountered along the western Olin property boundary and the northern portion of the property in shallow overburden groundwater (potentially oxygenated) and in bedrock groundwater south and southwest of the containment area. In addition, hexavalent chromium was detected and exceeded its tap water RSL in approximately 10% of the samples collected. Given that these detections do not appear to be random, the Report shall be revised to include hexavalent chromium as a COC in groundwater.

74. Page 4-38, Section 4.4.6. This section identifies hydrazine, Kempore and Opex as Specialty Compounds. However, the list of Specialty Compounds in the RI/FS Work Plan was more expansive and included dimethylformamide (DMF), phthalic anhydride, hydrazine, acetaldehyde, formaldehyde, nonylphenol, perchlorate, diphenylamine, tin, and the products Opex® and Kempore®. The Report shall be revised to discuss all of the Specialty Compounds identified in the RI/FS Work Plan.

75. Page 5-1, Section 5.1. This paragraph is inaccurate and shall be deleted. DAPL is an ongoing source of contamination to the surrounding groundwater in the aquifer. There is no evidence of chemical equilibrium presented or discussed in this Report. Based on an evaluation of the trends in the analytical data conducted by EPA's contractor, the extent of contamination in the

aquifers continues to expand indicating that equilibrium has not occurred. This expansion is governed by the typical processes associated with uncontrolled groundwater flow. In addition, there are also elevated levels of certain chemical compounds in the shallow and deeper overburden groundwater (i.e., NDMA is present at hundreds to thousands of ng/l in the overburden aquifer) which are also ongoing sources of contamination to the downgradient aquifer. This paragraph shall be revised to describe DAPL as an ongoing source of contamination to the rest of the aquifer. In addition, the Report shall also include a discussion of the other sources including the uncontained and migrating overburden groundwater containing elevated concentrations of COCs.

76. Section 5.1, DAPL Pools. The text states that "DAPL concentrations have not increased in DAPL based monitoring data from 2003 – 2001." The Report shall define "DAPL concentration," and provide the monitoring data that support this statement.

77. Pages 5-1 to 5-5, Section 5.1. In addition to individual sources, the Report shall describe areas of groundwater impacts and indicate these areas on figures. The areas of groundwater impacts may coincide with known source areas or may not, but these areas shall be described and potential sources identified.

78. Page 5-4, Section 5.1. The Report states "It is believed the bedrock underlying the WBV [Western Bedrock Valley] was initially, and perhaps extensively impacted by DAPL, and now encompasses a broad area of diffuse groundwater with bedrock. This would be consistent with findings of bedrock borings installed around the perimeter of the DAPL pools (GW-202BR, GW-406BR, and MP-4). These wells contain diffuse groundwater, not DAPL, with few exceptions." Additional evidence and explanation is required regarding why only the diffuse groundwater and not DAPL has penetrated the bedrock fractures. The Report shall provide a more thorough explanation of this issue.

79. Page 5-5, 3rd bullet. The Report states "The origin of NDMA is not known but precursor studies performed of DAPL and Diffuse Layer material did not indicate it forms in DAPL or diffuse chemical environments." The Report shall explain the source of NDMA even if the precursor studies could not replicate the field conditions. The Report shall include an analysis of NDMA concentration correlated with other compounds such as ammonia, sulfate, hydrazine, formaldehyde, or acetaldehyde; as well as correlations with depth, pH, and other characteristics. See also comment 61, above.

80. Page 5-5, 3rd bullet. The first word of the 3rd sentence shall be NDMA, not DAPL.

81. Page 5-5, last bullet. The Report shall discuss the presence and extent of hexavalent chromium.

82. Page 5-5. The paragraph titled "Domestic Gray Water" shall be deleted from the Report. Residential septic systems were not studied as potential sources of NDMA in the RI. Concentrations of NDMA in overburden groundwater significantly exceed the 8 to 80 ng/l of NDMA referenced in this study. Also, the Town of Wilmington is largely served by a municipal sewer system.

83. Page 5-6, Section 5.2.1. The 3rd paragraph states that the on-property DAPL pool is no longer considered to be a source of dissolved constituents to overburden groundwater. NDMA

concentrations at the GW-202 cluster, downgradient of the slurry wall, remain elevated from shallow overburden to deep bedrock. This suggests that either the slurry wall is not sufficiently protective or that significant residual contamination remains in the subsurface south of the containment cell. It is not clear that the ongoing contamination is entirely from the Main Street DAPL plume. Therefore, the on-property DAPL pool shall be discussed specifically as an ongoing source to the downgradient aquifers.

84. Page 5-7, Section 5.2.2, 1st and 2nd paragraph. Figure 4.4.1-1a clearly shows a plume of NDMA in shallow groundwater beneath the Maple Meadow Brook wetland, extending from GW-82S to MP-5 to GW-65S. These locations also have relatively high chloride concentrations and sodium concentrations relative to other monitoring wells in the MMBW. Kempore and hydrazine have been detected in MMBW surface water. Therefore, the MMBW may be potentially impacted by contaminated shallow groundwater. The text shall be revised accordingly.

85. Page 5-7, Section 5.2.2, 5th paragraph. The numerical model is presented in Appendix H, not Appendix K as indicated. This reference shall be corrected.

86. Page 5-7 to 5-8, Section 5.2.2. The conclusions that the "removal of DAPL as remediation strategy will not contribute significantly to groundwater restoration for fractured bedrock," and "Since the same matrix diffusion effects apply to bedrock located under the MMB aquifer, restoration of that aquifer is also improbable or impracticable due to the long-time frame back diffusion would occur from the affected rock matrix," are not supported by the available data set and shall be deleted. The data documents a significant volume of DAPL in the deep overburden aquifer and in shallow fractures. The data further documents that active chemical diffusion from the DAPL to the overlying and underlying groundwater continues, resulting in several diffuse groundwater plumes, and a broad overlying groundwater plume. The conclusions in the numerical model, and the model itself, are outside the scope of the remedial investigation, and shall be removed from discussion here. Such models may be discussed and considered in the feasibility study during the development and evaluation of remedial alternatives. In addition, any model utilized, including its purpose and input parameters shall be reviewed and approved by EPA before its use. References to this model throughout the Report shall be deleted.

87. Pages 5-7 to 5-8, Section 5.2.2. The Report contends that the overburden and bedrock aquifers are connected and that pumping the overburden aquifer would depress the bedrock aquifer, and therefore pull contaminants from the bedrock to the overburden.
    a. Given the thickness and apparent high conductivity of the overburden aquifer in the vicinity of the MMBW, and the lack of definitive connection between the bedrock and overburden in this area, the Report's conclusion is not supported. The Report has not provided a rigorous evaluation of pumping vs. non-pumping conditions on the overburden and bedrock aquifer. A pumping test or series of pumping tests would help to evaluate the extent to which overburden pumping would pull in bedrock groundwater. In lieu of this data, the Report shall include a comparison of hydraulic data collected before and after pumping cessation.
    b. Olin provides additional support for the potential connection between bedrock and overburden groundwater during pumping in Section 1.4.2 of the Draft OU3 FS Report (AMEC, 2018), describing trends in GW-103D. An evaluation of the trends for the parameters described in the Draft OU3 FS Report in the wells closest to the Chestnut

Street pumping wells (GW-103 cluster and GW-63 cluster), as well as the wells closest to the next-closest pumping wells (GW-64 cluster and GW-86 cluster), did not demonstrate a consistent trend for these parameters. The Report shall include trend charts and a full evaluation of these trends to evaluate the potential for overburden-bedrock connection.

88. Page 5-8, Section 5.2.3. The next to last bullet is speculative and not supported by the available data set. There is no data to demonstrate transfer of NDMA into the bedrock matrix. This bullet shall be deleted.

89. Page 5-8, Section 5.2.3. Additional routes of migration include the following, which shall be added to the text:
    a. Shallow groundwater migration from the central portion of the MMBW to surface water.
    b. Interception of contamination by private well pumping, causing sporadic NDMA detections.

90. Page 5-9, Section 5.3. The Report shall include leaching of contaminants from soil as a potential transport mechanism in groundwater.

91. Page 6-1 BHHRA Summary. The Report shall be revised to include the private potable wells on Cook Avenue in the analysis.

92. Page 7-2. The Report states "The hydraulic conductivity of the slurry wall is less than 1E-8 cm/sec. Based on extensive evaluation, there are no hydraulic indications that the function of the slurry wall is compromised in any way." The HPIT failed to determine anything about the hydraulic conductivity of the slurry wall and raised suspicion that the water traveled through bedrock fractures in and around the containment area. This statement shall be deleted from the Report. The Report also states: "The on-Property DAPL pool is not considered a source of current impacts to South Ditch." This statement shall be revised to clarify that the on-property DAPL pool is a contributing source of impacts to the south ditch and to the overburden and bedrock aquifers.

93. Page 7-2. The Report states "Restoration of fractured bedrock is also believed to be technically impracticable due to the long-time frame NDMA has been in contact with bedrock at high concentrations and the fate and transport characteristics of NDMA as described and corroborated by the model." Additional information is needed to support this conclusion, and it shall be removed from the Report.

94. Page 7-3. The Report states "There is no evidence to indicate NDMA is currently forming in DAPL or diffuse groundwater or has ever done so." Just because the formation of NDMA could not be replicated in a lab setting, does not mean that it did not form in the aquifer, and/or during the manufacturing process. The Report shall provide further explanation, with supporting data, regarding the source of NDMA.

95. Appendix A shall include all available boring logs and well construction logs, not just the logs created during the RI field investigations. The RI Report shall be a complete record of the Site and the reader should not be required to locate this information in other reports. Appendix A would therefore be referenced instead of the "previous reports" mentioned in Section 2.1.2.10

and in other sections, as needed.

96. Appendix D shall include all available borehole geophysics results available, not just those from the RI field investigations.

Appendix 1 - Attachment 1: Figures to Accompany Review of OU3 RI and Related Documents

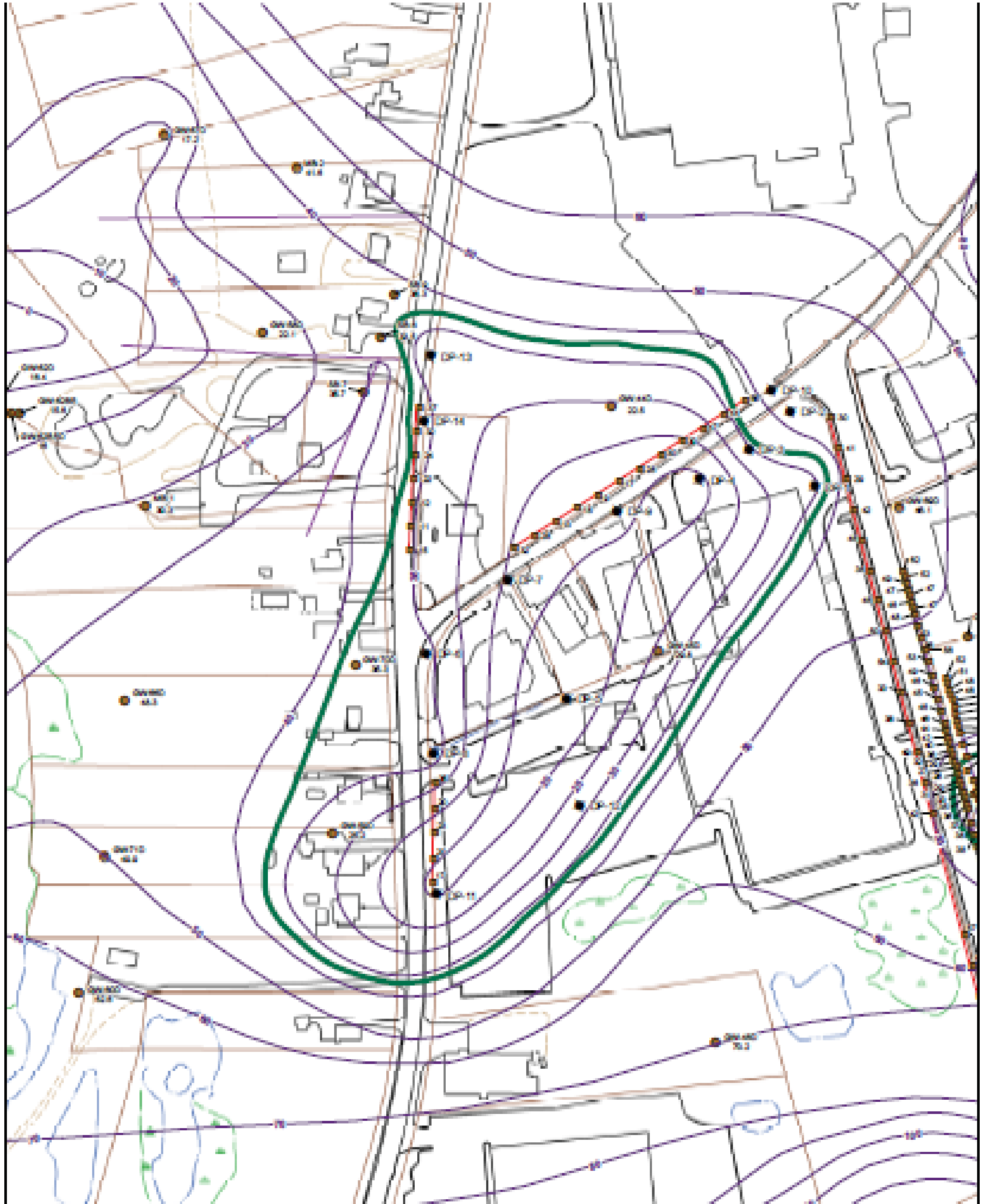
Figures to Accompany Review of OU3 RI and related Documents Olin Chemical Superfund Site Wilmington, MA

Revised CSM for Main Street DAPL Pool

W. C. Brandon

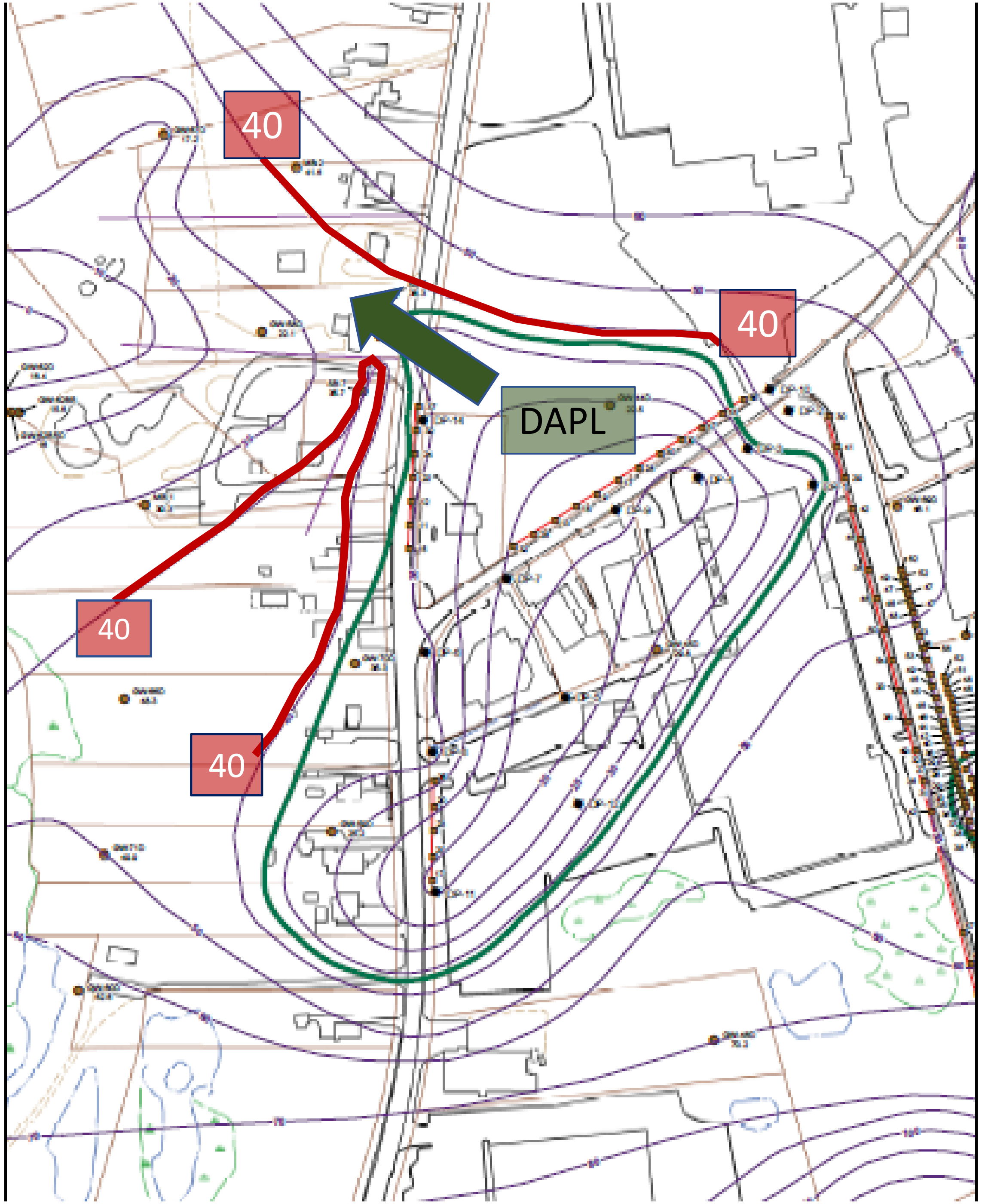
September 2018

Main Street DAPL Pool: *A Closer Look*

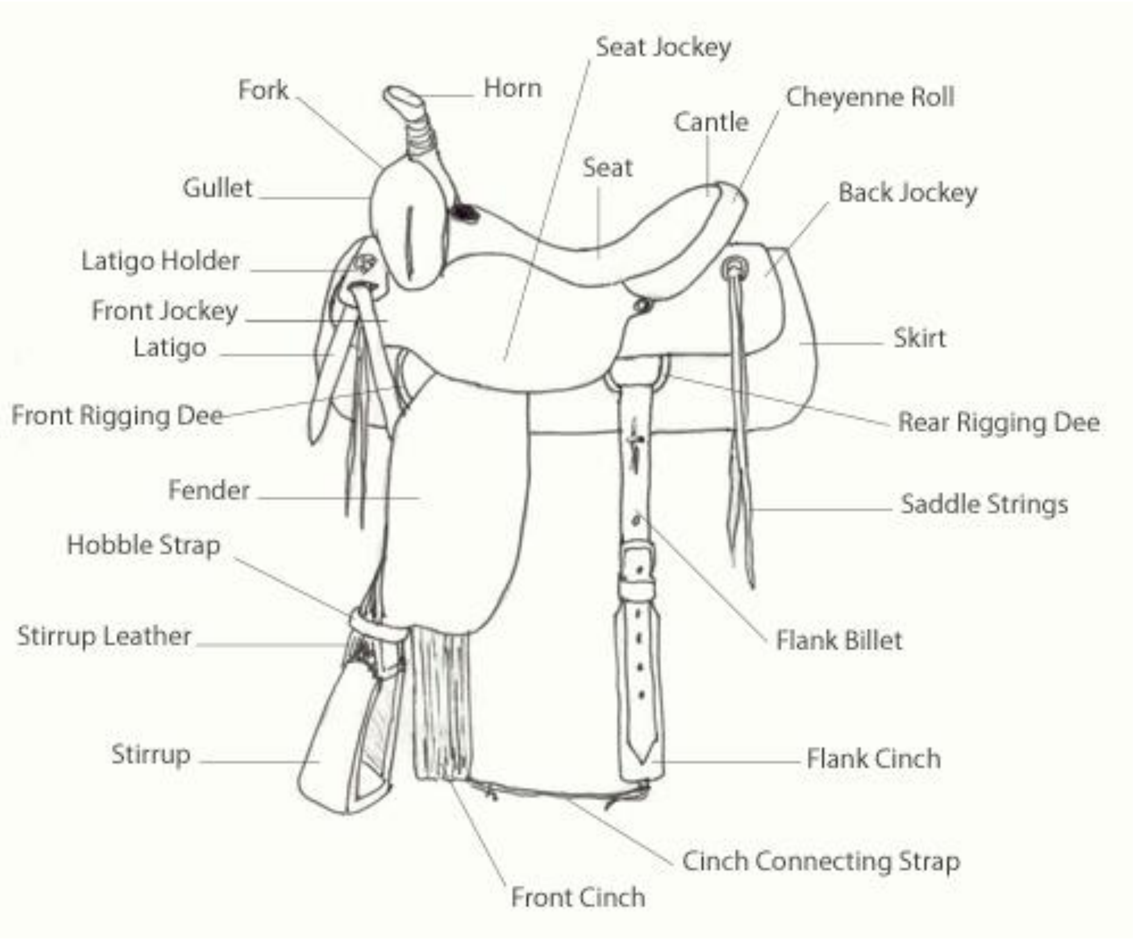


“Saddle” Theory

- What is a “Saddle”
- Is its’ location and shape accurately depicted?
- What data *supports* this?
- What data does *__not__* support this?
- Where are the key data gaps?
- Should the “Saddle” theory be revised, replaced, or updated to appropriately inform the CSM?

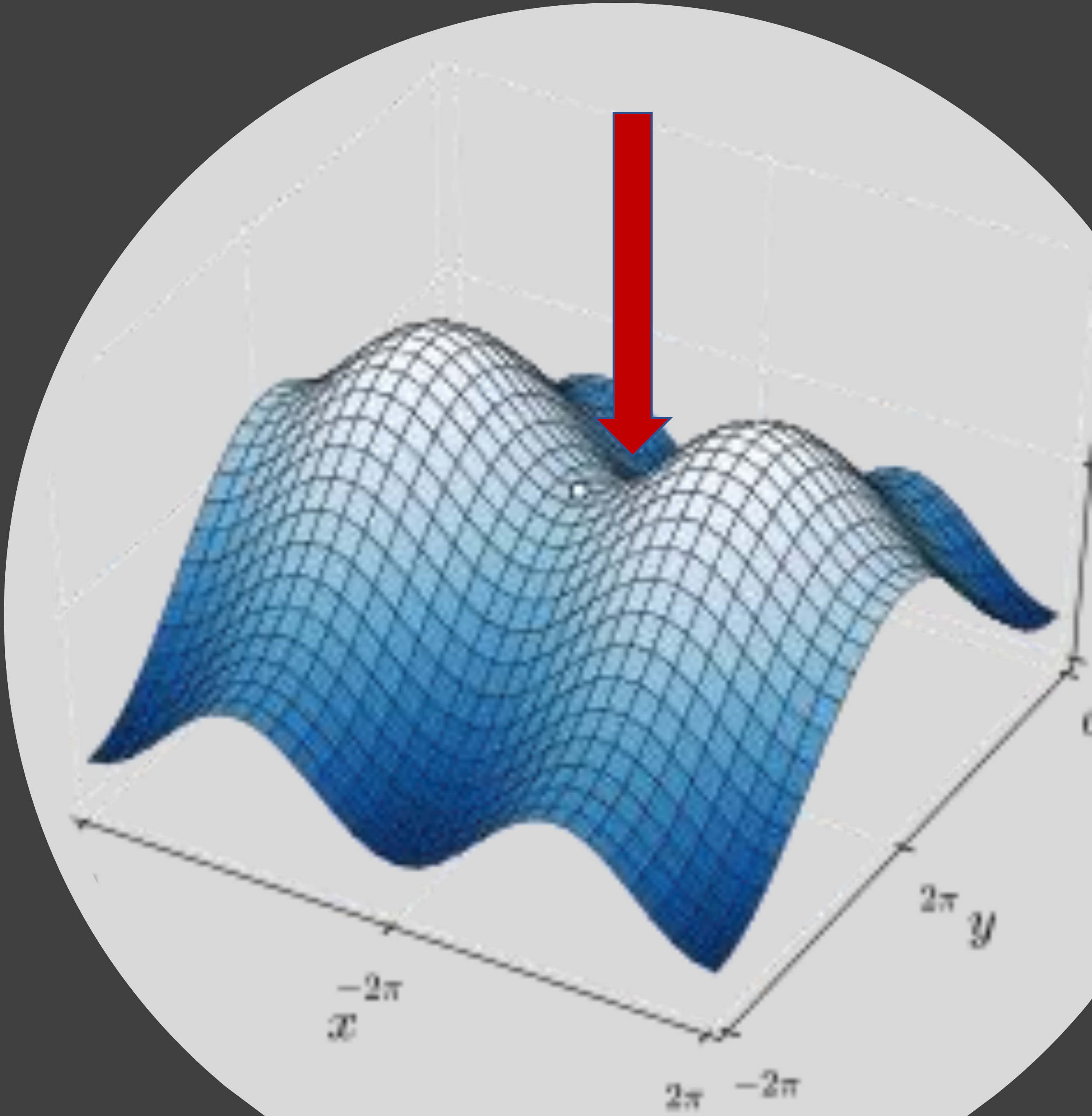


Saddles and Morphology



A common term used to refer to the low-area between adjacent promontories

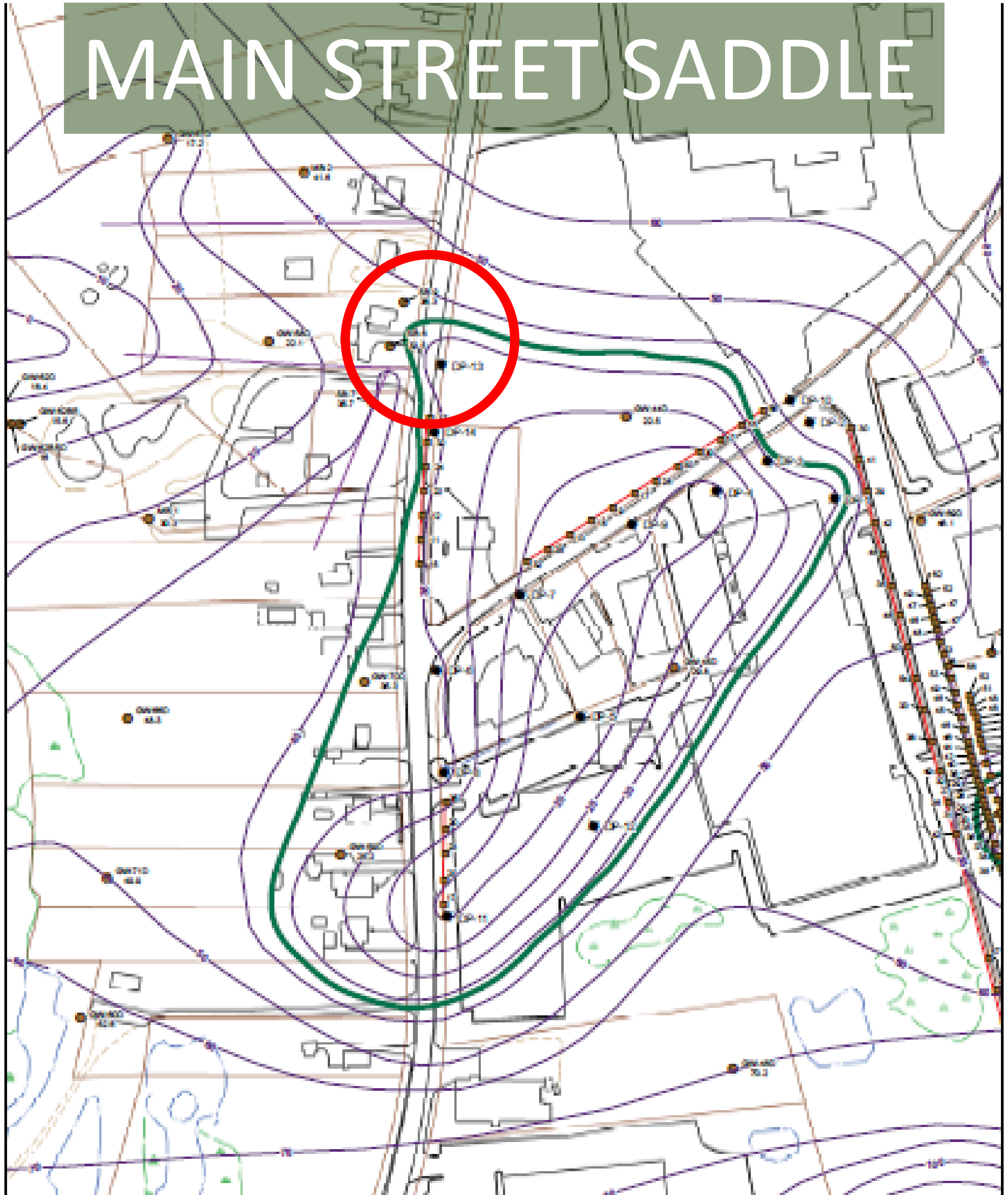
“Saddle” in Topographic Mapping

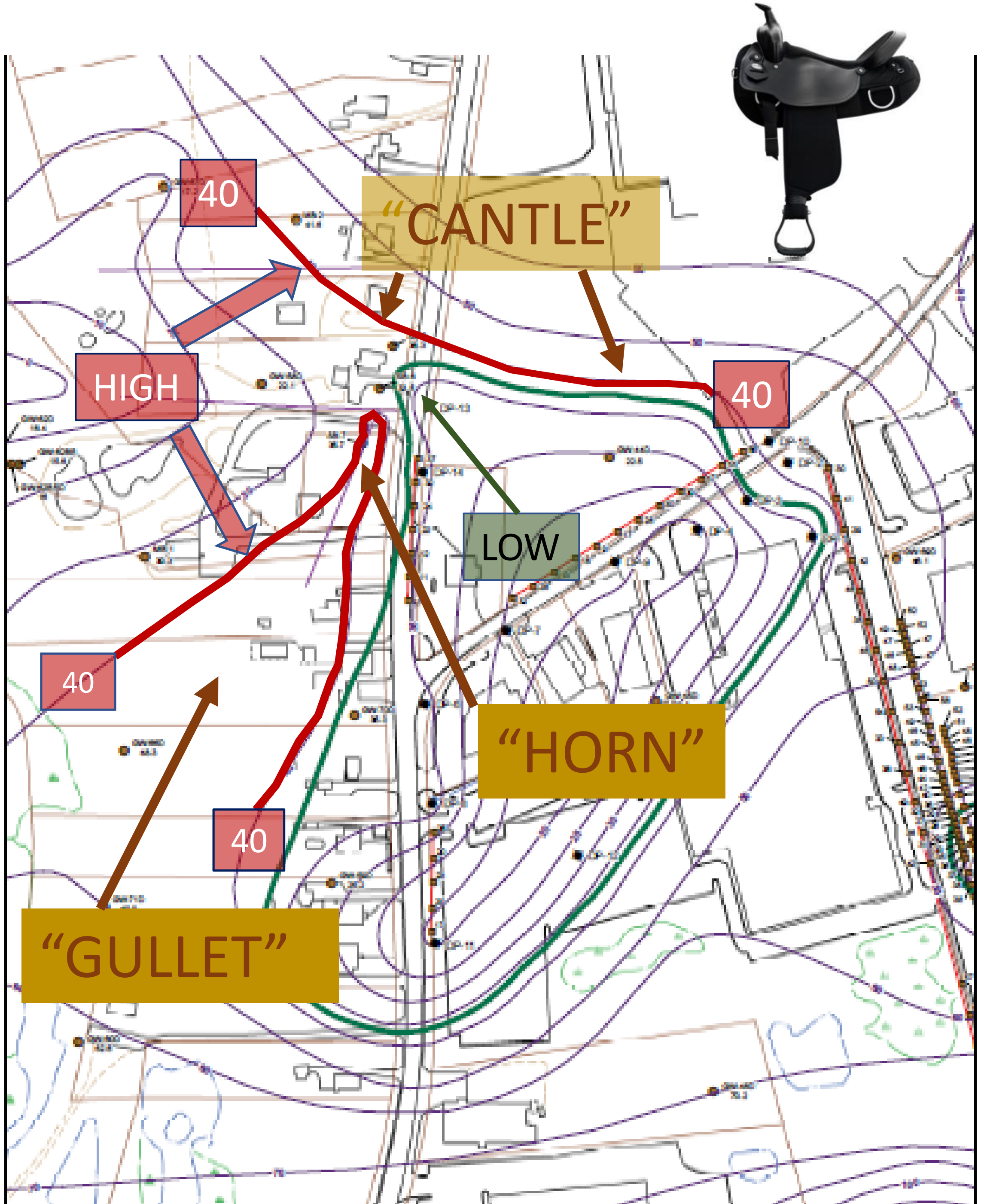


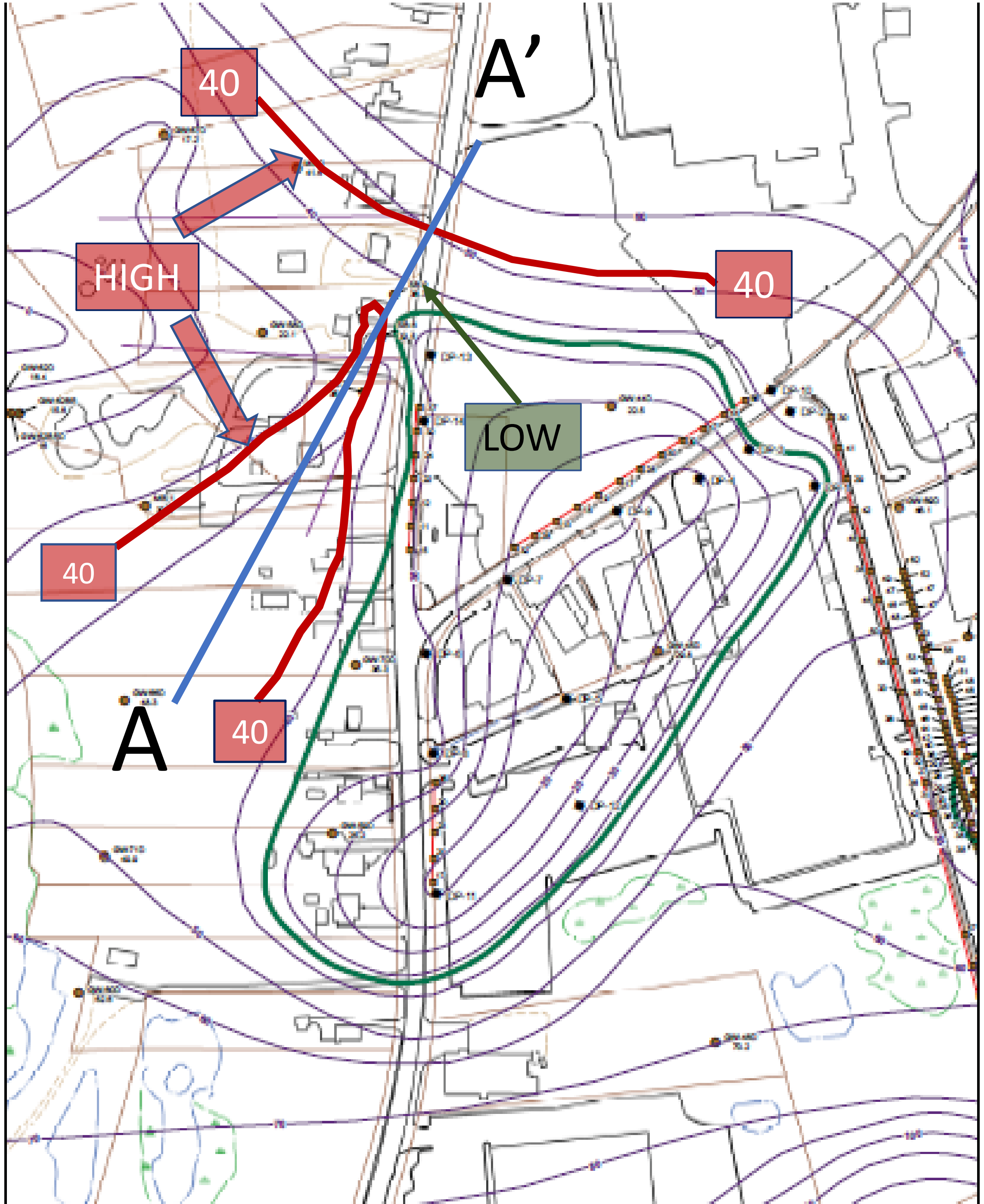
What is meant by the term "Saddle" in the OCSS site context?

- In this context, the term refers to:
- A relatively low-elevation region on the top-of-bedrock surface
- Flanked by higher elevation regions
- A "notch" or "trough"
- Density-driven flow generally flow follows the topography of the top-of-bedrock surface
- DAPL migration to the NW/downgradient is interpreted to have been guided by the so-called "Main Street Saddle"

MAIN STREET SADDLE



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A’
HIGH
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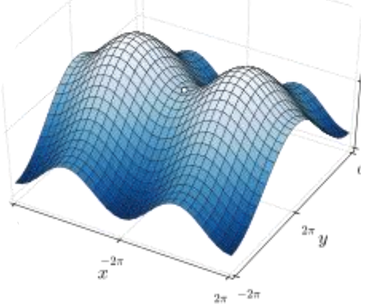
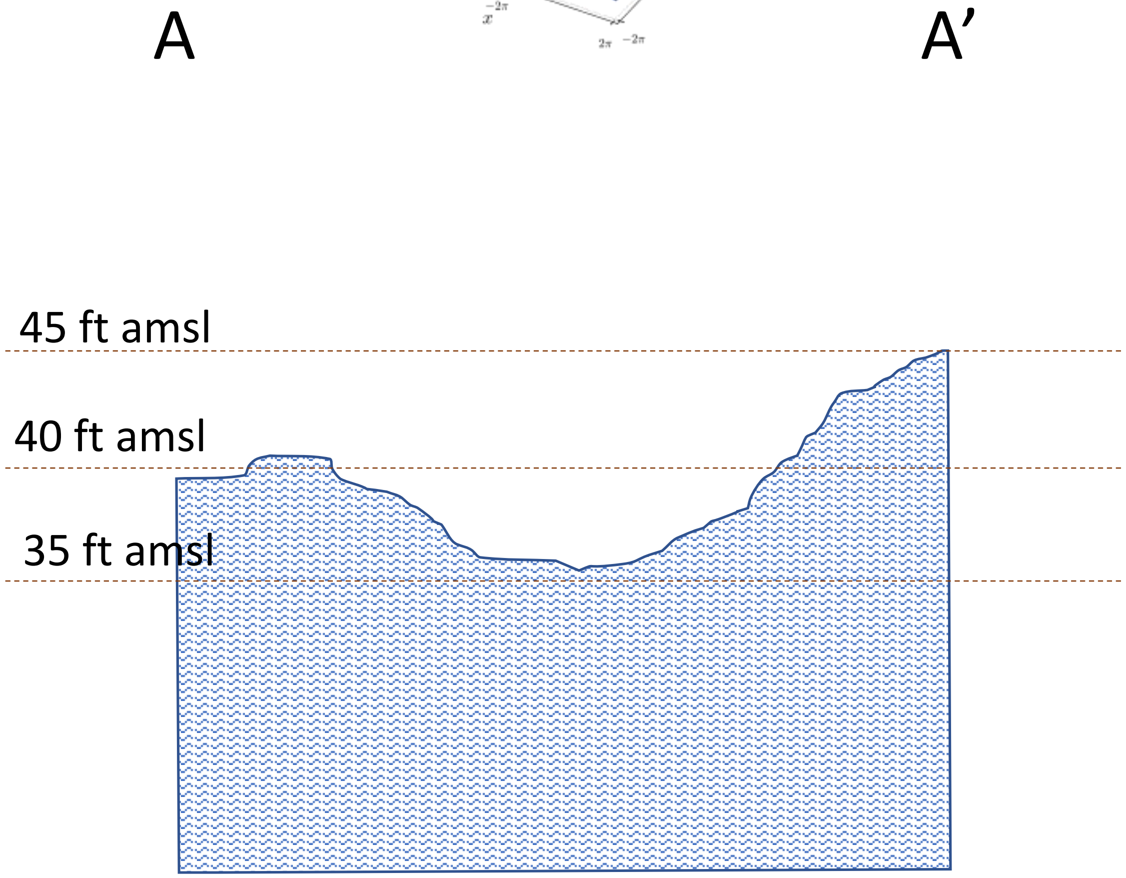
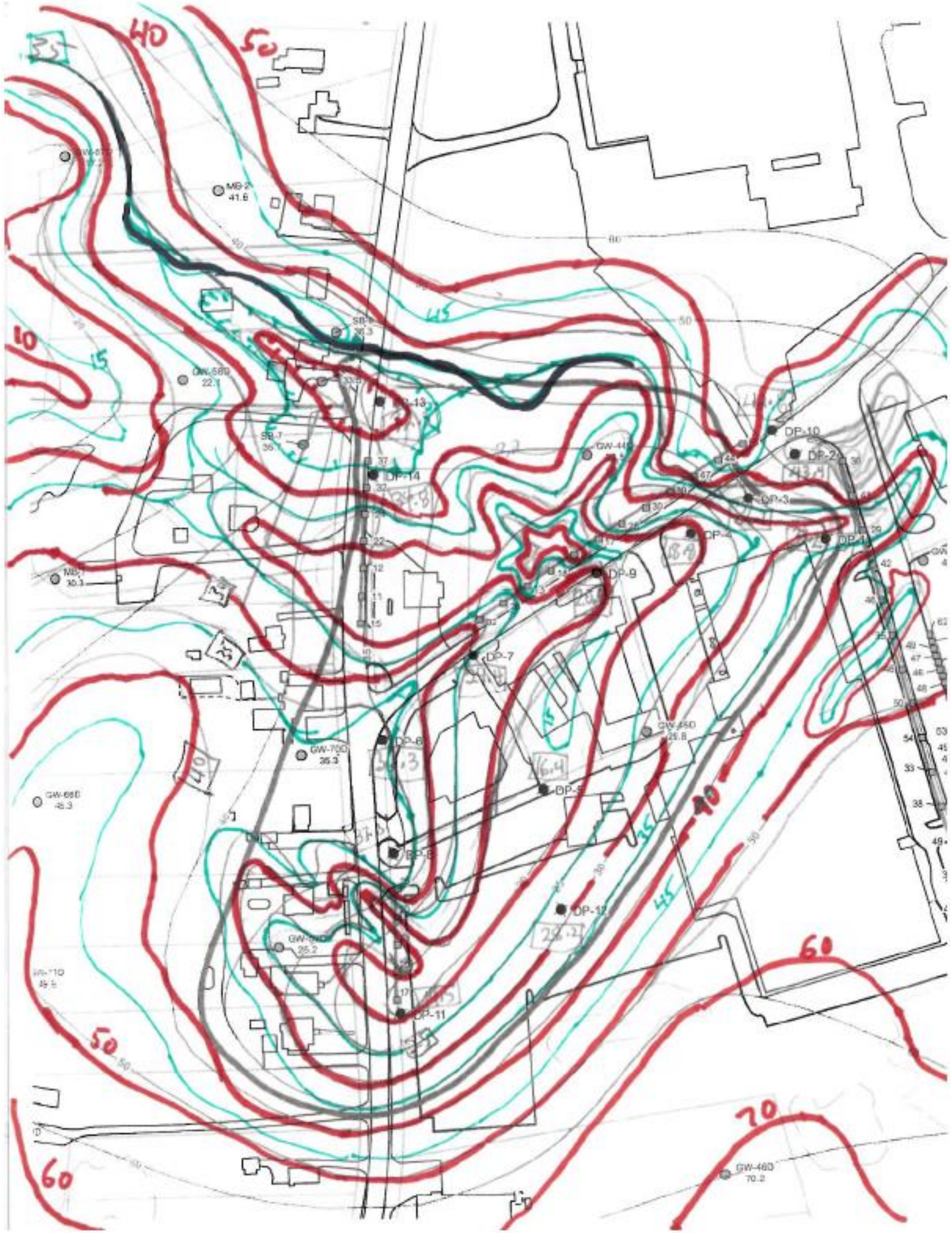


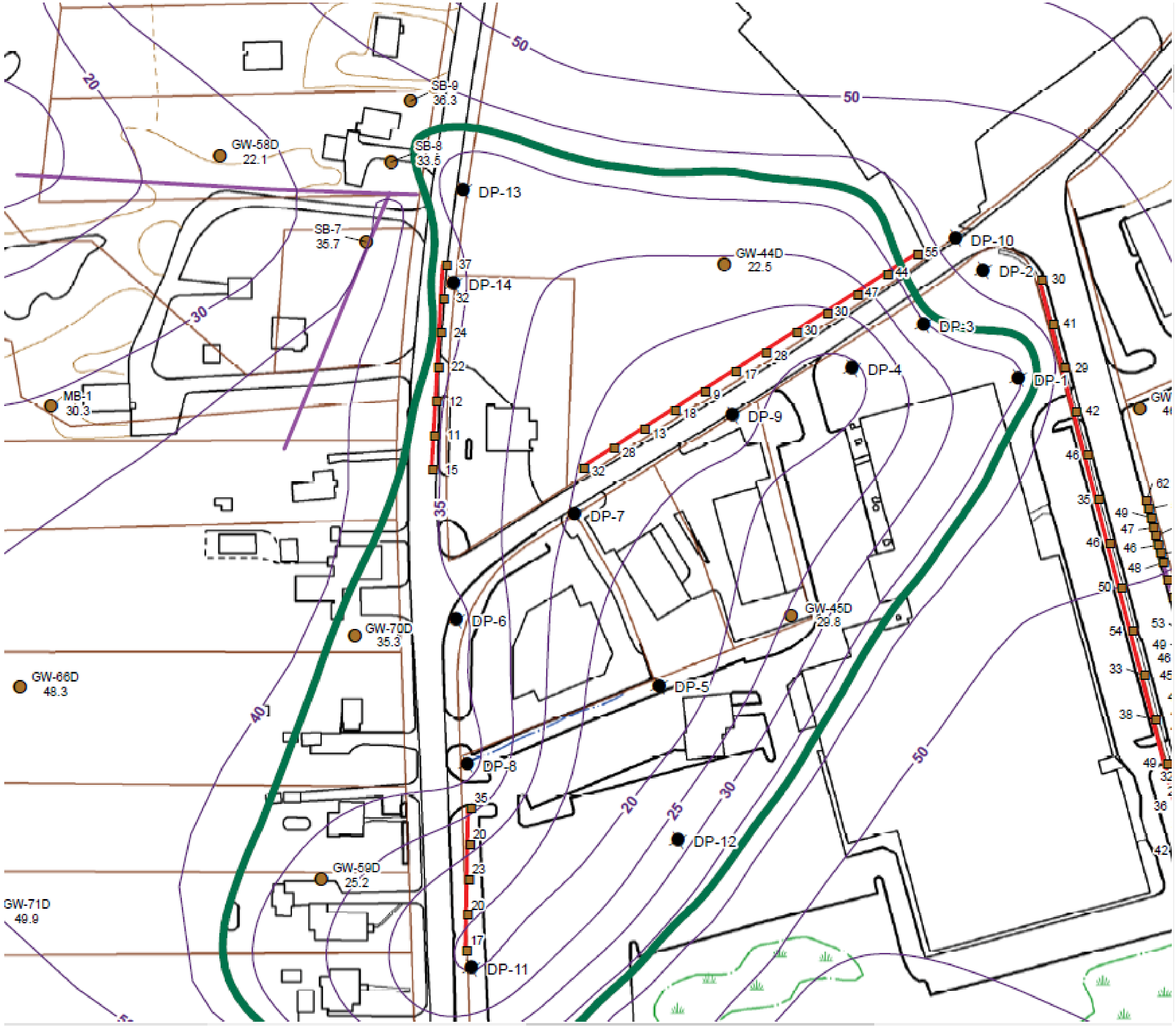

A
A’
45 ft amsl
40 ft amsl
35 ft amsl

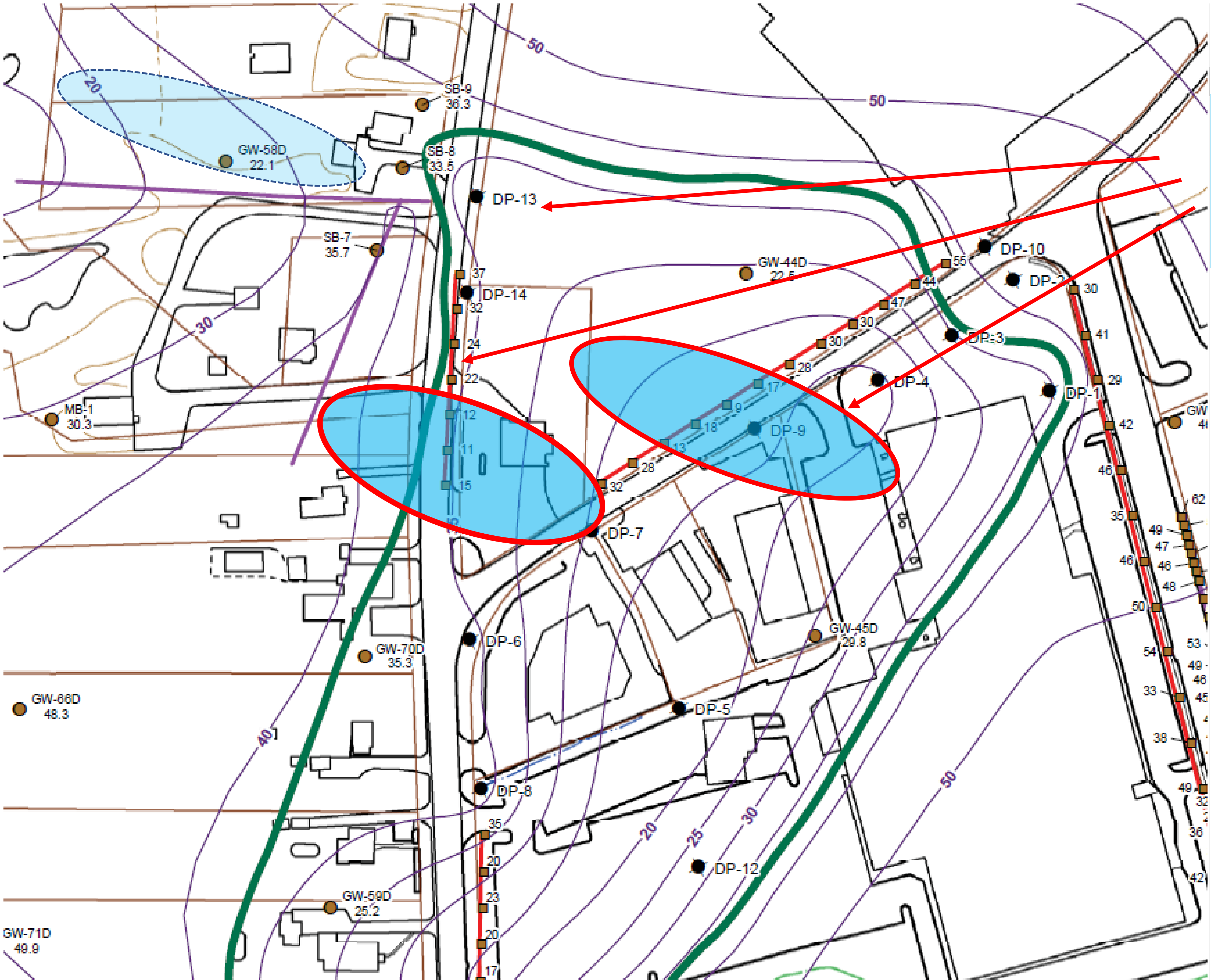
Main Street "Saddle" Reinterpreted

- Honors all data presented:
- TOR elevations from seismic
  - elevations supplied by others
  - Seismic 'picks' not verified
- TOR elevations from Boring data
- TOR surface reinterpreted and hand-contoured



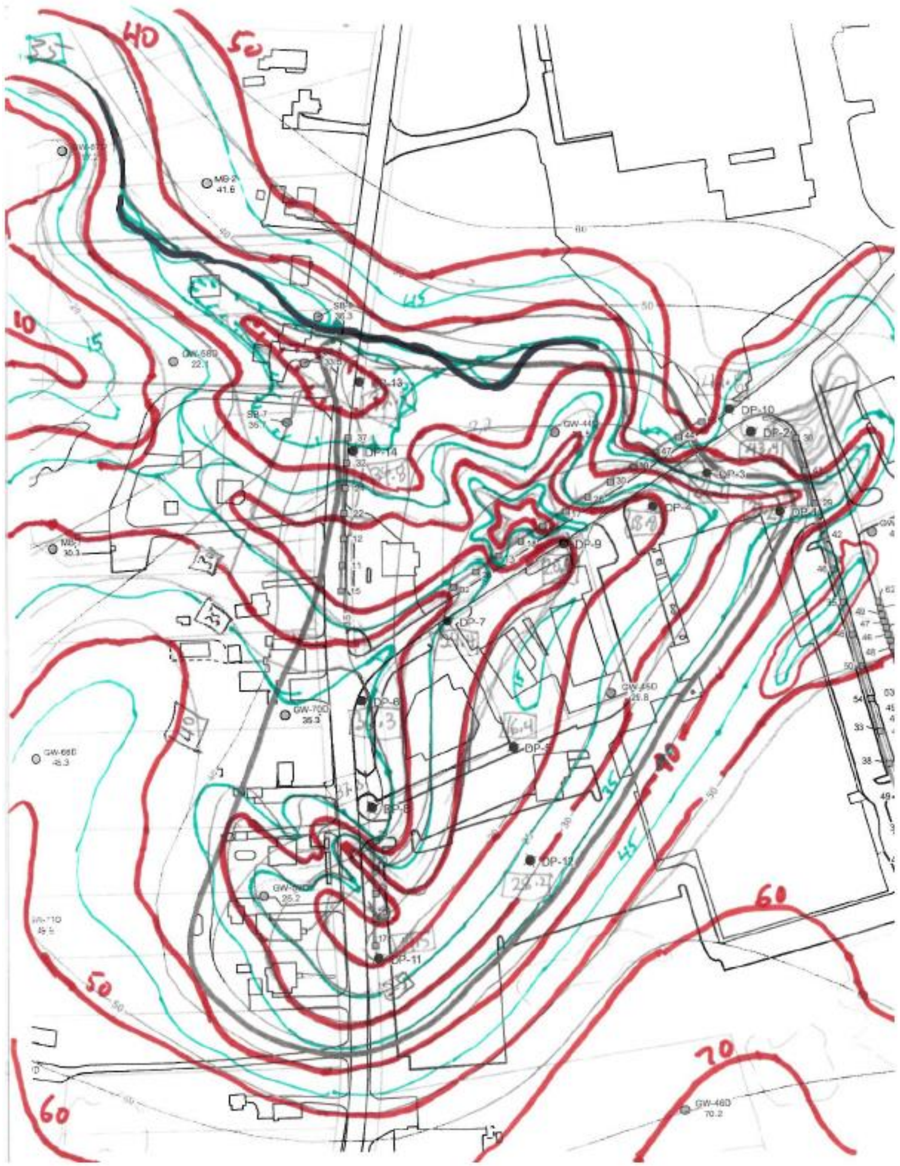
Close-up of Main Street Area Showing Specific Elevation Data

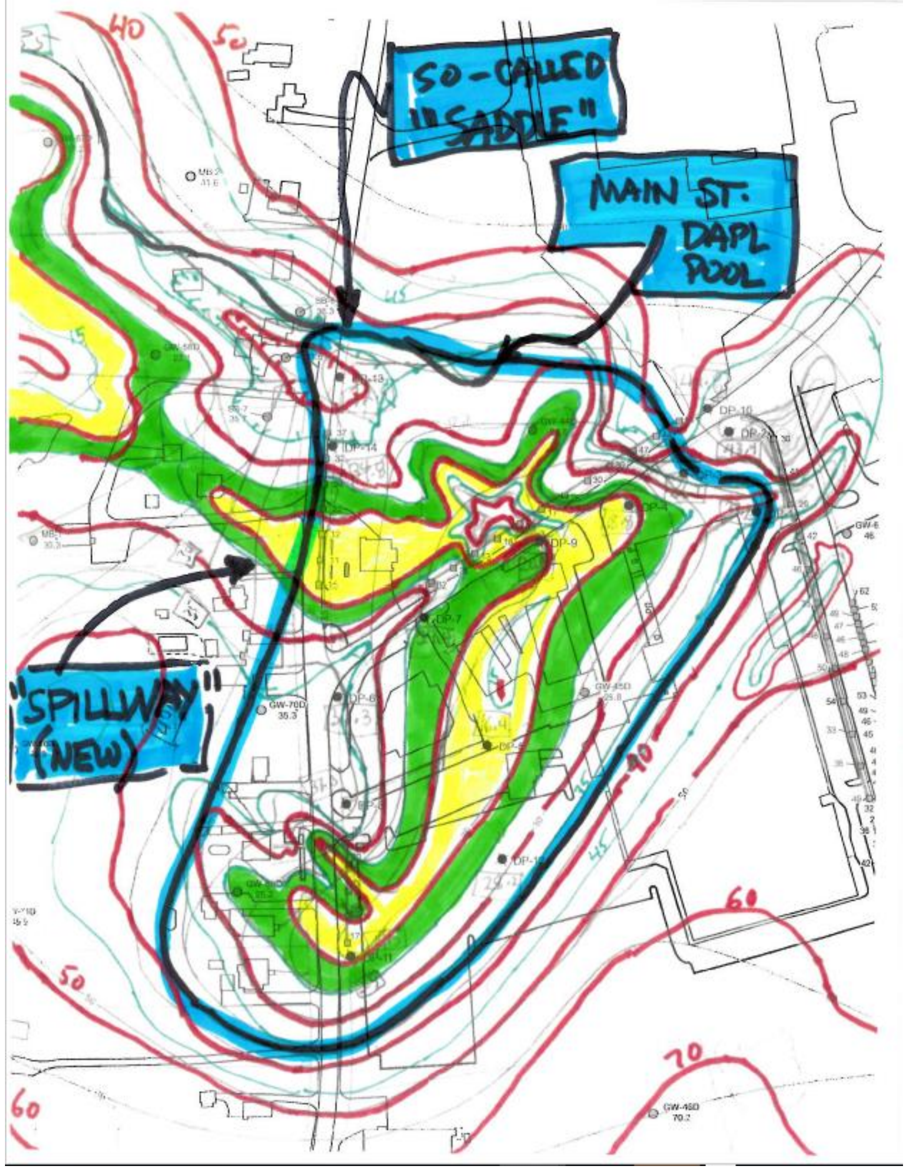


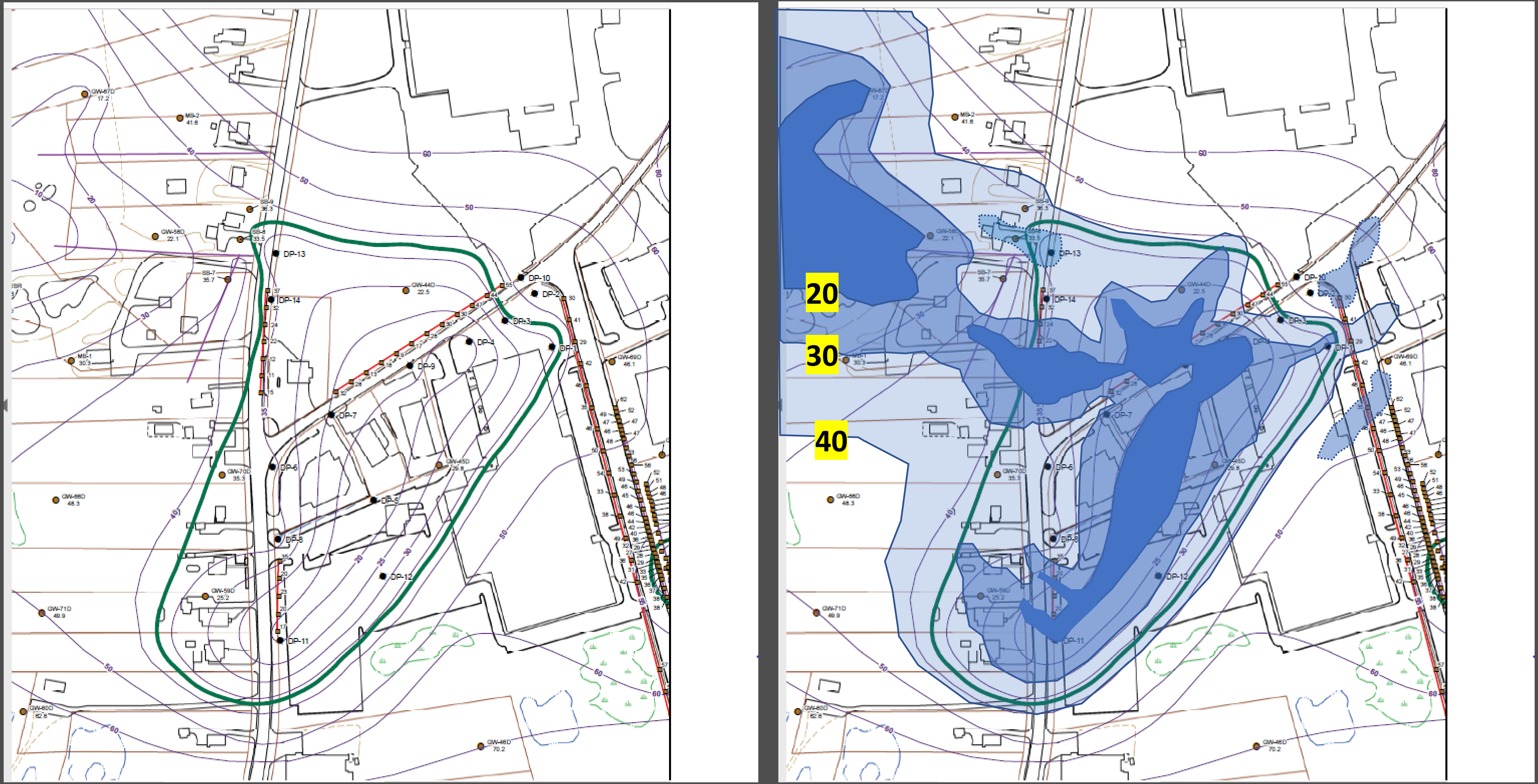


Deep topographic Lows:

Not represented on TOR Map




SO-CALLED "SADDLE"
MAIN ST. DAPL POOL
"SPILLWAY" (NEW)


DP-13
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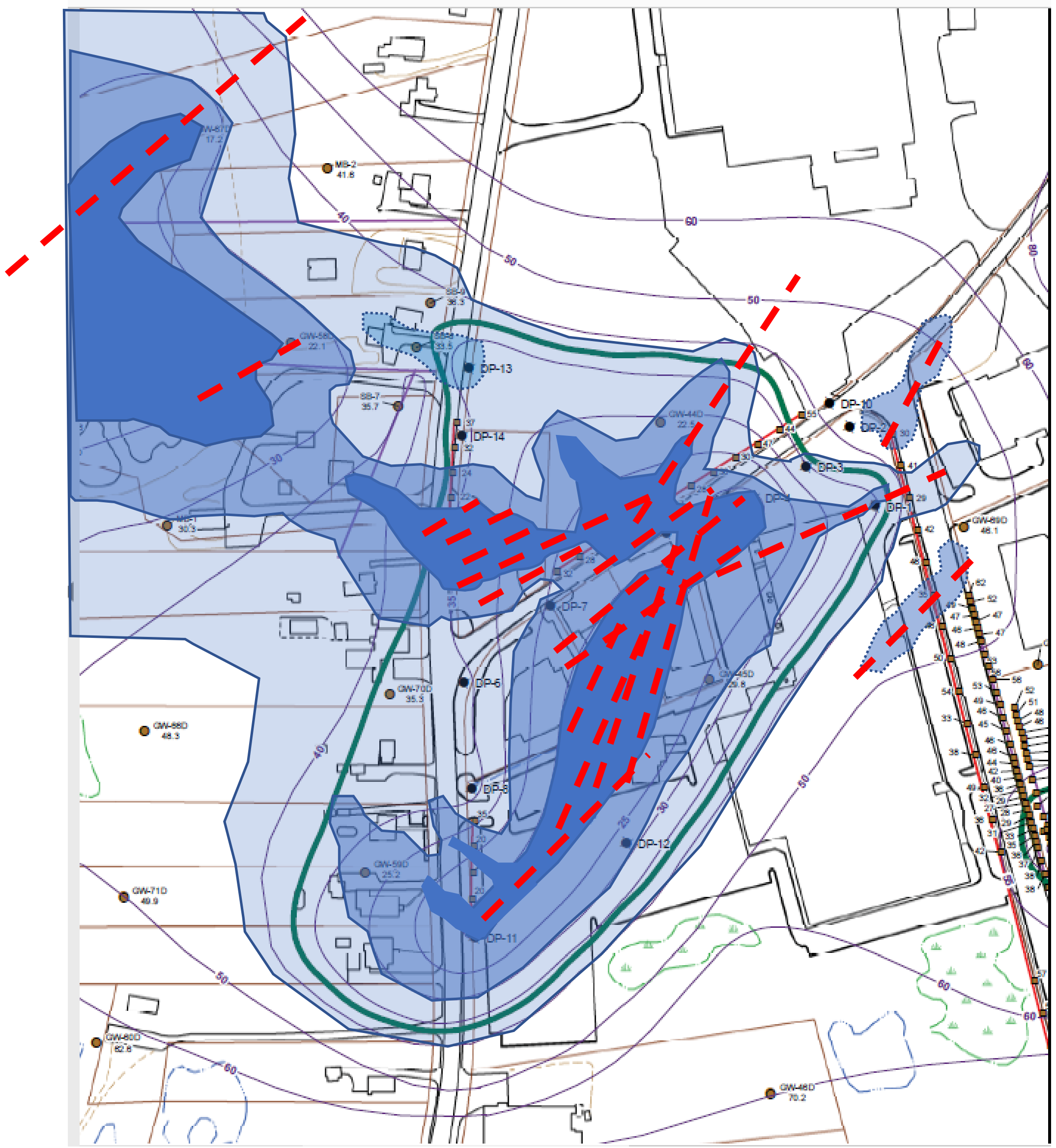
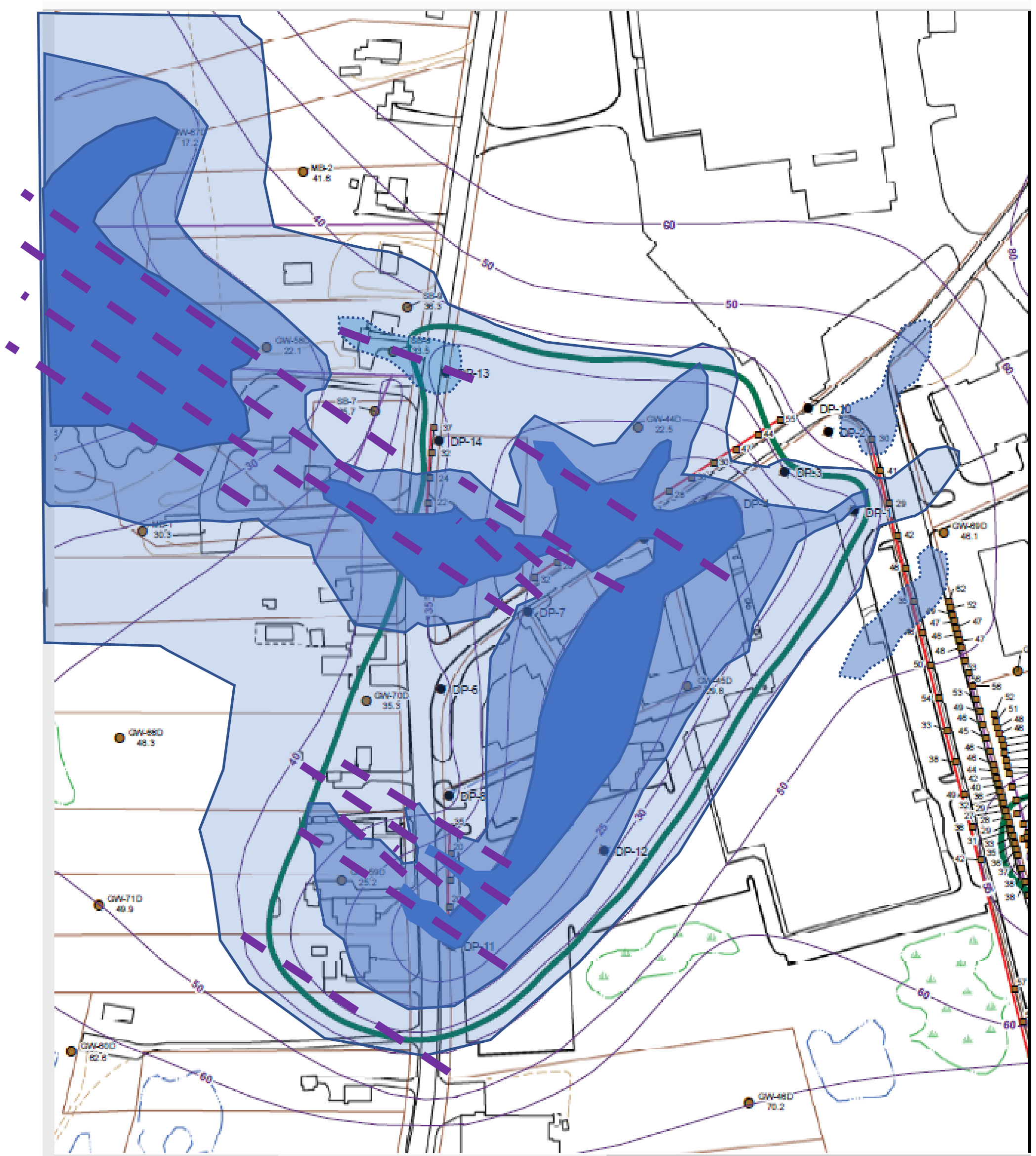
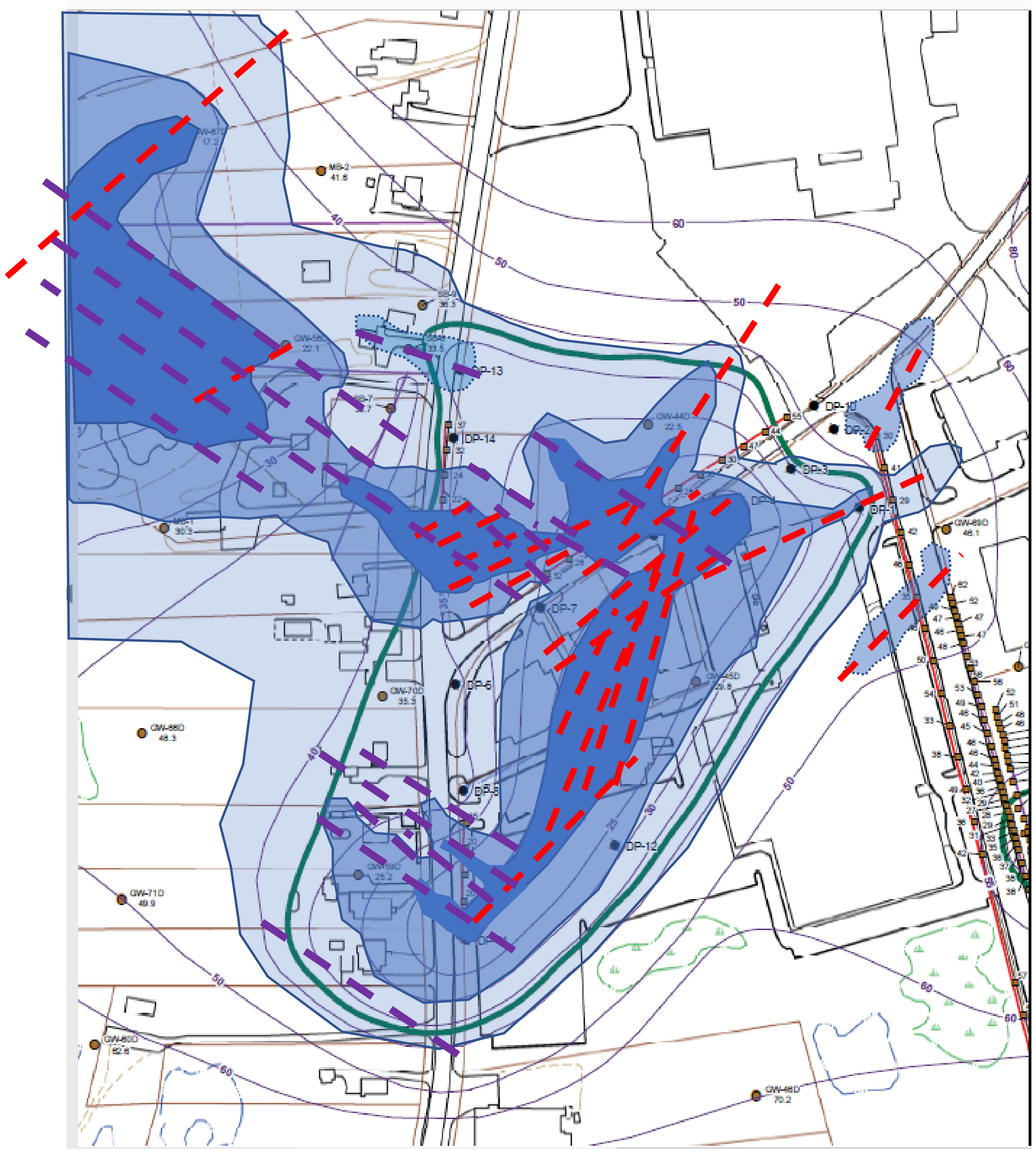
Potential NE-Striking Fractures (Interpreted)



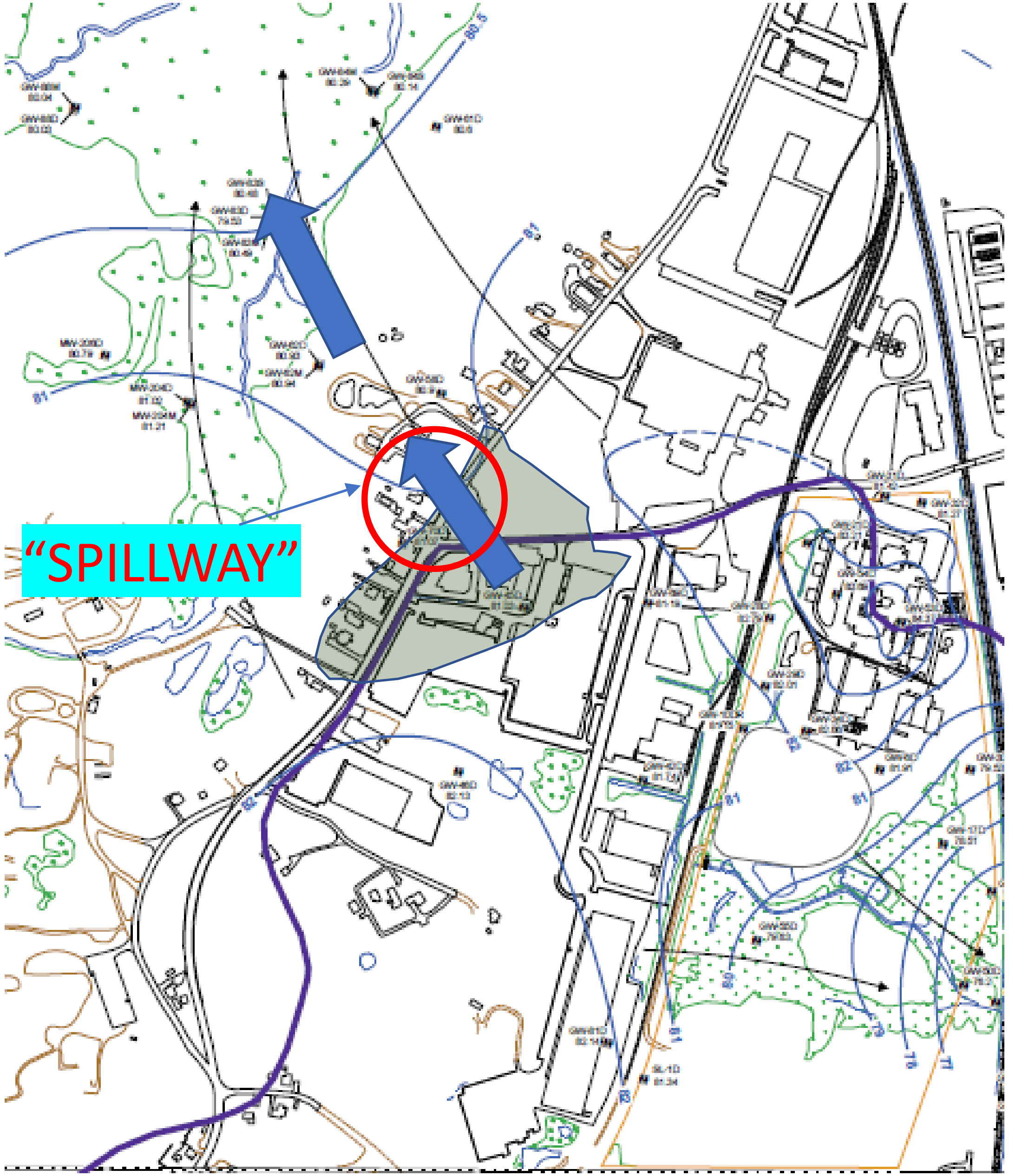
Potential NW-Striking Fractures (Interpreted)

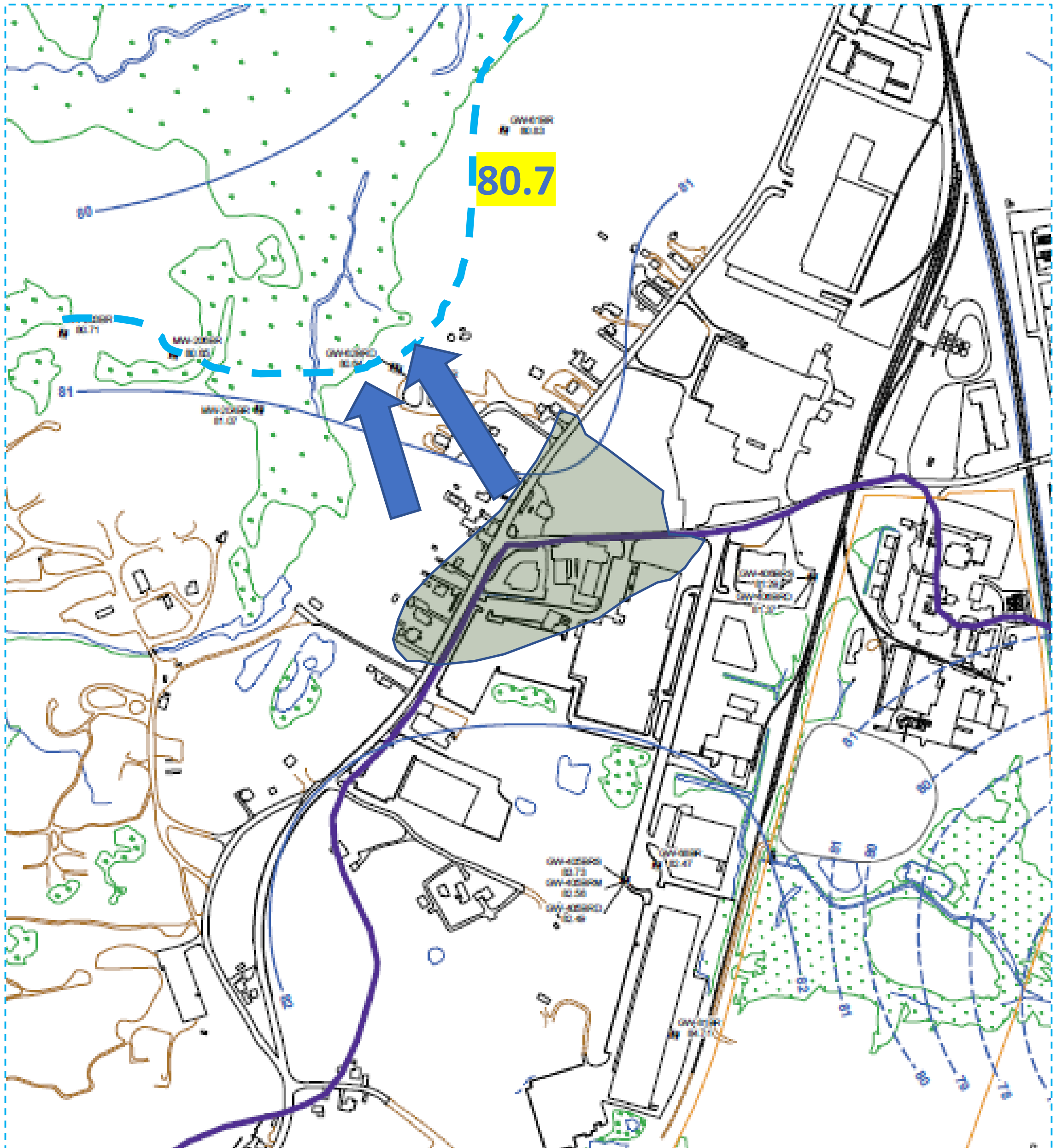


Combined NW – NE Fracture Network (Interpreted)

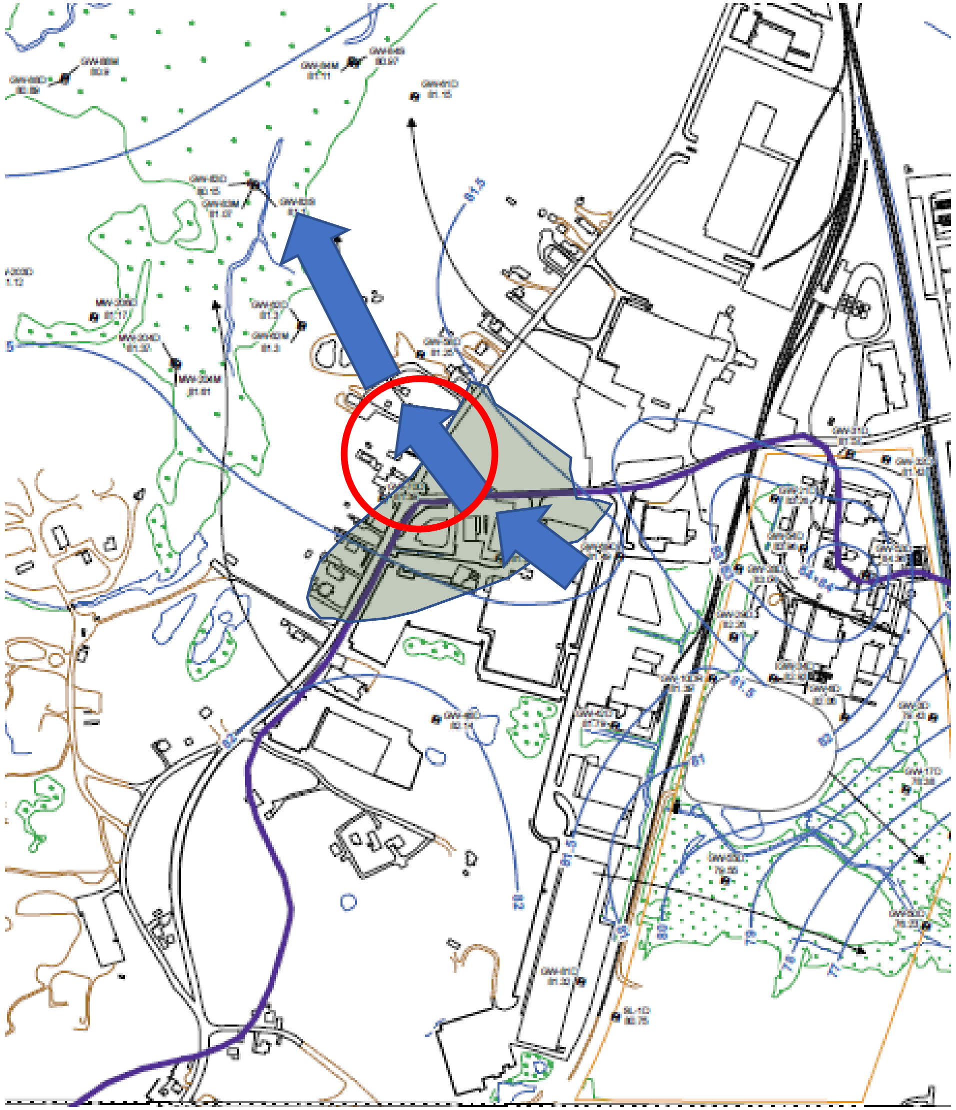


GW Elevations and interpreted Flow Vectors

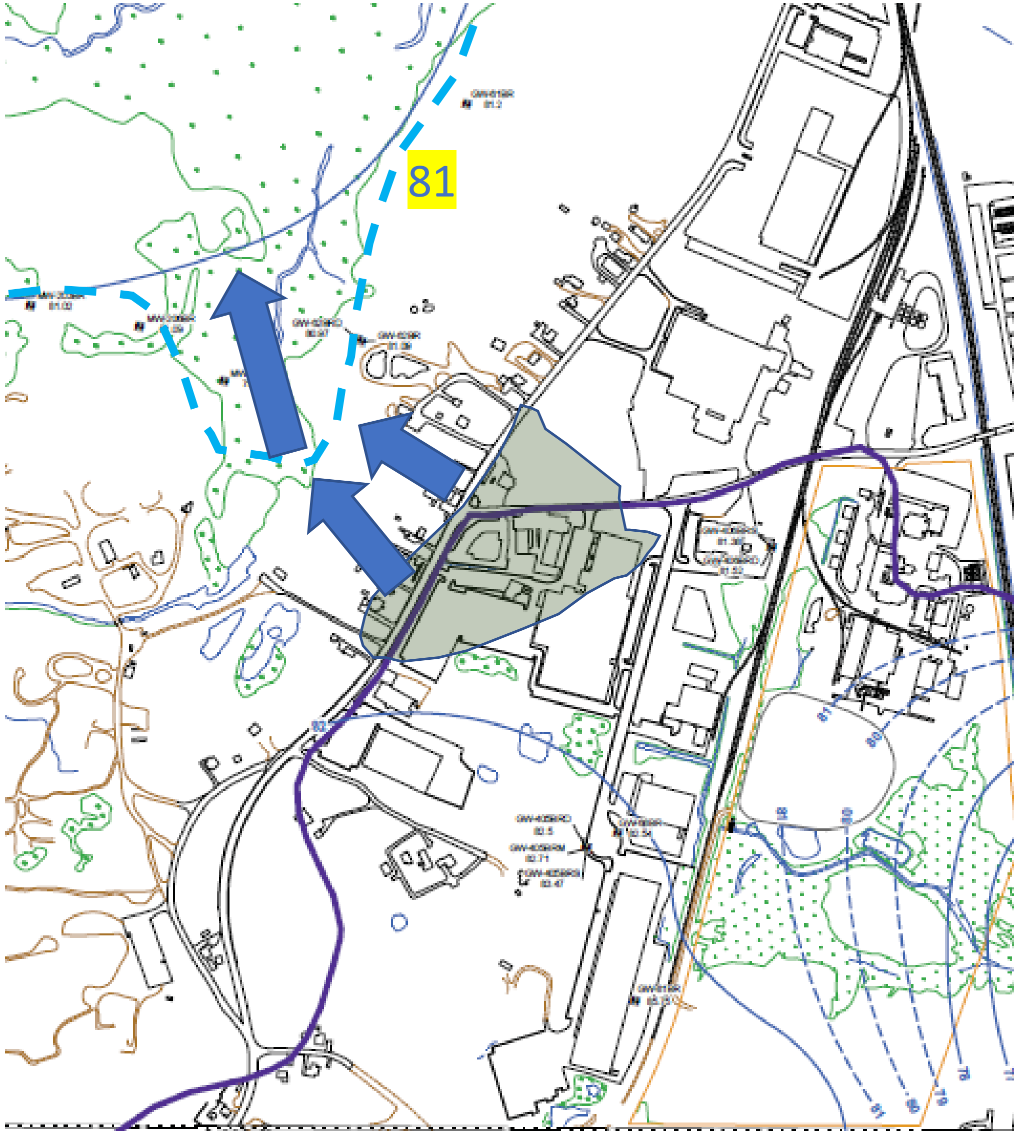




GW Elevations and Interpreted Flow Vectors



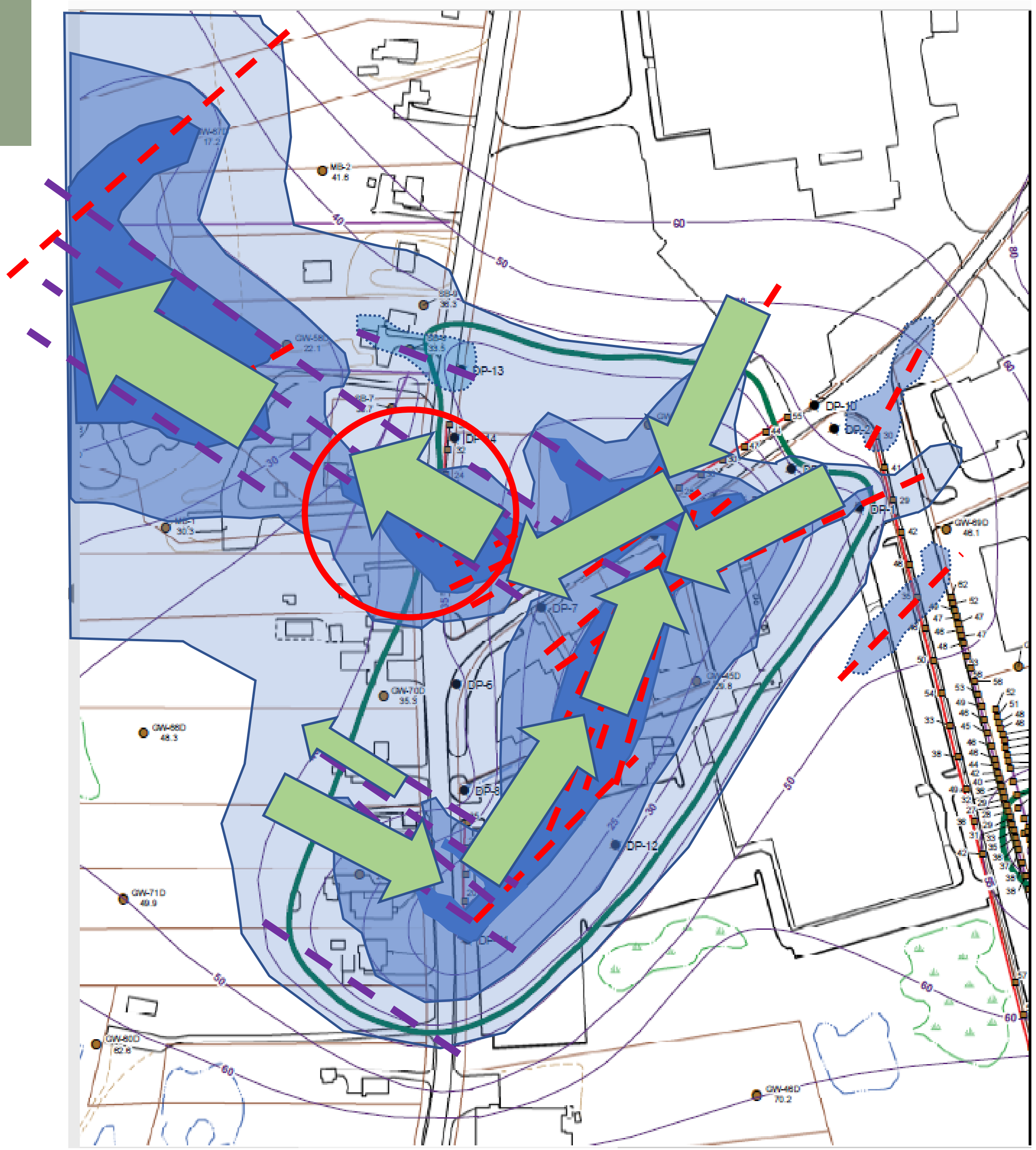
Deep Overburden – October 2011



Bedrock – October 2011

DAPL Migration Pathways (Interpreted)

- Gravity-Driven Migration
  - TOR Surface controlled component
  - Fracture-Controlled component
- Hydraulic-Driven Migration
  - Head Gradients (General)
  - Fracture-Controlled Flow



Main Street DAPL Area – Preliminary Conclusions

- A recontouring of TOR elevation data in the Main Street DAPL pool area results in a new interpretation.
- A new feature tentatively called the Main Street “Spillway” is identified approximately 300 feet to the SW of the previously-identified feature called the “Main Street Saddle”
- The “Main Street Saddle” appears to be a smaller scale feature of lesser importance.
- Based on the shape of the TOR surface, the Main Street “Spillway” is interpreted to correlate with a series of tightly-spaced NW-striking steeply-dipping fractures

Main Street DAPL Area – Preliminary Conclusions (cont.)

- Another series of fractures which strike NE are also interpreted based on significant large-scale grooves on the TOR surface of this orientation.
- The features are likely related to layer-parallel faulting and fracturing or stratigraphic variations in composition and character of the layered metamorphic rock.
- The NE-striking features are interpreted to dip moderately to steeply to the NW based on borehole data from across the OCSS.
- Together with the NW-striking features, and the likely presence of shallowly-dipping “sheeting fractures” in the shallower portions of the bedrock, a well interconnected network of fractures appears to exist.

Main Street DAPL Area – Preliminary Conclusions (cont.)

- This interconnected fracture network combined with the shape of the TOR surface likely provides a variety migration pathways from the DAPL area to the low-lying wetland and stream areas to the northwest.
- The Main Street "Spillway" appears to be the dominant controlling hydrogeologic feature which influences both density-driven contaminant migration as well as groundwater flow in overburden and bedrock
- The "Spillway" appears to control/direct groundwater flow to the northwest from the Main Street DAPL area.
- The TOR surface shows a pronounced large-scale groove complex which slopes to the northwest from the Main Street "Spillway" to the wetlands beyond.
- This groove has a strong influence on both deep overburden and Bedrock groundwater flow
- Deep overburden and Bedrock Groundwater head gradients and flow vectors are both consistently oriented to the northwest.

Main Street DAPL Area – Preliminary Conclusions (cont.)

- A series of tightly-spaced NW-striking fractures interpreted to underlie the NW-striking “groove” on the TOR surface represent a significant previously unidentified structural element in the bedrock system.
- The system of structures is tentatively named the Wilmington-NW Fracture system
- The size and significance of this series of newly-identified features indicates that the current CSM is inadequate and needs updating.
- Additional information on the bedrock in the areas beneath and proximal to the Main Street DAPL area is needed.
- Additional data collection must include installation of new bedrock control points, particularly in downgradient areas to the NW of the Main Street DAPL pool which are currently unmonitored.

Appendix 1 - Attachment 2: Summary Statistics and Criteria Comparisons

Table 1
Groundwater Since May 2010
Summary Statistics and Criteria Comparisons
Olin Chemical, Wilmington, Massachusetts

Chemical	Units	Analyzed	Detects	Non Detects	Rejects	Min Det	Max Det	Avg Det	Freq Of Det	Det Range	Max Location	MCL		SMCL		RSL		Applicable Std.	Freq Of Exceed
												Value	# Exceed	Value	# Exceed	Value	# Exceed		
Volatile Organic Compounds																			
1,1,1-Trichloroethane	ug/L	426	2	424	0	0.4	3.8	2.1	0%	0.4 - 3.8	GW-80D	200	0	NS	--	800	0	MCL	0.0%
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	426	4	422	0	0.81	15	5.5	1%	0.81 - 15	GW-45D	NS	--	NS	--	1000	0	RSL	0.0%
1,1-Dichloroethane	ug/L	426	46	380	0	0.21	230	8.45	11%	0.21 - 230	GW-80BR	NS	--	NS	--	2.8	6	RSL	1.4%
1,1-Dichloroethene	ug/L	426	16	410	0	0.2	1.1	0.486	4%	0.2 - 1.1	GW-80D	7	0	NS	--	28	0	MCL	0.0%
1,2,4-Trichlorobenzene	ug/L	426	12	414	0	0.26	2	0.883	3%	0.26 - 2	GW-58D; GW-69D	70	0	NS	--	0.4	10	MCL	0.0%
1,2,4-Trimethylbenzene	ug/L	426	16	410	0	0.21	15	4.36	4%	0.21 - 15	GW-80D	NS	--	NS	--	5.6	4	RSL	0.9%
1,2-Dichlorobenzene	ug/L	426	19	407	0	0.21	200	22.5	4%	0.21 - 200	GW-80BR	600	0	NS	--	30	2	MCL	0.0%
1,2-Dichloroethane	ug/L	426	52	374	0	0.26	23	4.22	12%	0.26 - 23	GW-45D; GW-83D	5	11	NS	--	0.17	52	MCL	2.6%
1,3,5-Trimethylbenzene	ug/L	426	6	420	0	0.26	2.3	1.06	1%	0.26 - 2.3	GW-80D	NS	--	NS	--	6	0	RSL	0.0%
1,3-Dichlorobenzene	ug/L	426	4	422	0	0.61	2.4	1.33	1%	0.61 - 2.4	GW-202D	NS	--	NS	--	NS	--		
1,4-Dichlorobenzene	ug/L	426	19	407	0	0.35	5.2	1.25	4%	0.35 - 5.2	GW-80D	75	0	NS	--	0.48	15	MCL	0.0%
1,4-Dioxane	ug/L	206	2	204	219	19	85	52	1%	19 - 85	GW-80D	NS	--	NS	--	0.46	2	RSL	1.0%
1-Pentene, 2,4,4-trimethyl-	ug/L	489	123	366	0	0.5	2100	382	25%	0.5 - 2100	GW-16R	NS	--	NS	--	NS	--		
2,4,4-Trimethyl-2-Pentene	ug/L	489	104	385	0	0.38	830	139	21%	0.38 - 830	GW-16R	NS	--	NS	--	NS	--		
2-Butanone	ug/L	425	10	415	1	1.3	25	10.4	2%	1.3 - 25	MP-3 #01	NS	--	NS	--	560	0	RSL	0.0%
2-Chlorotoluene	ug/L	426	2	424	0	2.1	2.2	2.15	0%	2.1 - 2.2	GW-80D	NS	--	NS	--	24	0	RSL	0.0%
4-Chlorotoluene	ug/L	426	2	424	0	0.84	0.87	0.855	0%	0.84 - 0.87	GW-80D	NS	--	NS	--	25	0	RSL	0.0%
4-Isopropyltoluene	ug/L	426	3	423	0	0.37	0.43	0.41	1%	0.37 - 0.43	GW-70D; MP-4 #02	NS	--	NS	--	NS	--		
Acetone	ug/L	425	14	411	1	3.8	770	165	3%	3.8 - 770	GW-44D	NS	--	NS	--	1400	0	RSL	0.0%
Benzene	ug/L	426	52	374	0	0.2	110	8.56	12%	0.2 - 110	GW-80BR	5	11	NS	--	0.46	39	MCL	2.6%
Bromobenzene	ug/L	426	1	425	0	0.21	0.21	0.21	0%	0.21 - 0.21	GW-84D	NS	--	NS	--	6.2	0	RSL	0.0%
Bromochloromethane	ug/L	426	13	413	0	0.2	1.6	0.802	3%	0.2 - 1.6	MP-1 #06	NS	--	NS	--	8.3	0	RSL	0.0%
Bromodichloromethane	ug/L	426	23	403	0	0.22	7.5	2.02	5%	0.22 - 7.5	MP-1 #01	80	0	NS	--	0.13	23	MCL	0.0%
Bromoform	ug/L	426	21	405	0	0.59	55	12.7	5%	0.59 - 55	MP-1 #01	80	0	NS	--	3.3	16	MCL	0.0%
Carbon disulfide	ug/L	425	74	351	1	0.25	24	3.06	17%	0.25 - 24	MP-3 #01	NS	--	NS	--	81	0	RSL	0.0%
Carbon tetrachloride	ug/L	426	2	424	0	3	3.1	3.05	0%	3 - 3.1	GW-69D	5	0	NS	--	0.46	2	MCL	0.0%
Chlorobenzene	ug/L	426	23	403	0	0.36	1400	118	5%	0.36 - 1400	GW-80BR	100	2	NS	--	7.8	4	MCL	0.5%
Chloroethane	ug/L	426	12	414	0	0.29	1800	280	3%	0.29 - 1800	GW-80BR	NS	--	NS	--	2100	0	RSL	0.0%
Chloroform	ug/L	426	47	379	0	0.2	93	15.1	11%	0.2 - 93	MP-3 #01	80	4	NS	--	0.22	44	MCL	0.9%
Chloromethane	ug/L	426	20	406	0	0.2	3	1.05	5%	0.2 - 3	GW-44D; MP-3 #01	NS	--	NS	--	19	0	RSL	0.0%
cis-1,2-Dichloroethene	ug/L	426	78	348	0	0.25	190	22.4	18%	0.25 - 190	GW-407BRS	70	8	NS	--	3.6	30	MCL	1.9%
Cyclohexane	ug/L	426	7	419	0	0.2	8.8	3.82	2%	0.2 - 8.8	GW-80D	NS	--	NS	--	1300	0	RSL	0.0%
Dibromochloromethane	ug/L	426	21	405	0	0.24	170	12.4	5%	0.24 - 170	MP-1 #01	80	1	NS	--	0.87	17	MCL	0.2%
Dibromomethane	ug/L	426	18	408	0	0.33	11	4.22	4%	0.33 - 11	MP-1 #06	NS	--	NS	--	0.83	16	RSL	3.8%
Diethyl ether	ug/L	426	13	413	0	0.2	4.3	1.2	3%	0.2 - 4.3	GW-80D	NS	--	NS	--	390	0	RSL	0.0%

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												Value	# Exceed	Value	# Exceed	Value	# Exceed		
Diisopropyl Ether	ug/L	426	2	424	0	3.9	4.7	4.3	0%	3.9 - 4.7	GW-80D	NS	--	NS	--	150	0	RSL	0.0%
Ethylbenzene	ug/L	426	25	401	0	0.21	260	26.4	6%	0.21 - 260	GW-80BR	700	0	NS	--	1.5	18	MCL	0.0%
Isopropylbenzene	ug/L	426	8	418	0	0.34	4.8	1.8	2%	0.34 - 4.8	GW-80D	NS	--	NS	--	45	0	RSL	0.0%
m,p-Xylene	ug/L	426	13	413	0	0.52	850	141	3%	0.52 - 850	GW-80BR	10000	0	NS	--	19	6	MCL	0.0%
Methyl tert-butyl ether	ug/L	426	112	314	0	0.19	39	4.05	26%	0.19 - 39	MP-5 #08	NS	--	NS	--	14	7	RSL	1.6%
Methylcyclohexane	ug/L	426	5	421	0	2.4	9.2	6.02	1%	2.4 - 9.2	GW-80D	NS	--	NS	--	NS	--		
Methylene chloride	ug/L	426	28	398	0	1.4	270	19	7%	1.4 - 270	GW-80BR	5	15	NS	--	11	9	MCL	3.5%
Naphthalene	ug/L	426	7	419	0	0.35	13	3.09	2%	0.35 - 13	GW-45D	NS	--	NS	--	0.17	7	RSL	1.6%
n-Butylbenzene	ug/L	426	2	424	0	0.8	1.1	0.95	0%	0.8 - 1.1	GW-80D	NS	--	NS	--	100	0	RSL	0.0%
n-Propylbenzene	ug/L	426	11	415	0	0.29	5.7	1.87	3%	0.29 - 5.7	GW-80D	NS	--	NS	--	66	0	RSL	0.0%
o-Xylene	ug/L	425	18	407	0	0.2	200	23.7	4%	0.2 - 200	GW-80BR	10000	0	NS	--	19	3	MCL	0.0%
sec-Butylbenzene	ug/L	426	1	425	0	1.5	1.5	1.5	0%	1.5 - 1.5	GW-80D	NS	--	NS	--	200	0	RSL	0.0%
Styrene	ug/L	426	1	425	0	0.21	0.21	0.21	0%	0.21 - 0.21	B-10	100	0	NS	--	120	0	MCL	0.0%
tert-Amyl methyl ether	ug/L	426	9	417	0	0.34	2	1.2	2%	0.34 - 2	GW-58D	NS	--	NS	--	NS	--		
Tetrachloroethene	ug/L	426	14	412	0	0.22	3.1	1.24	3%	0.22 - 3.1	GW-58D	5	0	NS	--	4.1	0	MCL	0.0%
Tetrahydrofuran	ug/L	426	9	417	0	0.68	22000	5120	2%	0.68 - 22000	GW-80BR	NS	--	NS	--	340	4	RSL	0.9%
Toluene	ug/L	426	46	380	0	0.2	13000	523	11%	0.2 - 13000	GW-80BR	1000	2	NS	--	110	5	MCL	0.5%
trans-1,2-Dichloroethene	ug/L	426	17	409	0	0.26	78	9.8	4%	0.26 - 78	GW-80BR	100	0	NS	--	36	2	MCL	0.0%
Trichloroethene	ug/L	426	69	357	0	0.21	270	14.6	16%	0.21 - 270	GW-58D	5	25	NS	--	0.28	65	MCL	***5.9%***
Vinyl chloride	ug/L	426	38	388	0	0.24	83	9.68	9%	0.24 - 83	GW-87D	2	13	NS	--	0.019	38	MCL	3.1%
Semi-Volatile Organic Compounds																			
1,1'-Biphenyl	ug/L	563	28	535	0	0.48	27	2.74	5%	0.48 - 27	GW-15	NS	--	NS	--	0.083	28	RSL	5.0%
1,2,4,5-Tetrachlorobenzene	ug/L	563	1	562	0	4.8	4.8	4.8	0%	4.8 - 4.8	GW-405BRS	NS	--	NS	--	0.17	1	RSL	0.2%
1,2-Dichlorobenzene	ug/L	128	1	127	0	0.078	0.078	0.078	1%	0.078 - 0.078	GW-85D	600	0	NS	--	30	0	MCL	0.0%
2,4,6-Trichlorophenol	ug/L	538	5	533	25	0.48	1	0.664	1%	0.48 - 1	GW-83D	NS	--	NS	--	1.2	0	RSL	0.0%
2,4-Dichlorophenol	ug/L	538	22	516	25	0.091	3.1	1.06	4%	0.091 - 3.1	MP-3 #01	NS	--	NS	--	4.6	0	RSL	0.0%
2,4-Dimethylphenol	ug/L	539	5	534	24	0.49	8.6	3.12	1%	0.49 - 8.6	GW-80BR	NS	--	NS	--	36	0	RSL	0.0%
2,4-Dinitrophenol	ug/L	467	1	466	96	0.46	0.46	0.46	0%	0.46 - 0.46	GW-45D	NS	--	NS	--	3.9	0	RSL	0.0%
2,6-Dinitrotoluene	ug/L	563	9	554	0	0.15	9.5	1.89	2%	0.15 - 9.5	B-10	NS	--	NS	--	0.049	9	RSL	1.6%
2-Chlorophenol	ug/L	538	11	527	25	0.75	7.6	2.85	2%	0.75 - 7.6	MP-1 #01	NS	--	NS	--	9.1	0	RSL	0.0%
2-Methylnaphthalene	ug/L	563	9	554	0	0.046	0.32	0.135	2%	0.046 - 0.32	M-24/L-64	NS	--	NS	--	3.6	0	RSL	0.0%
2-Methylphenol	ug/L	540	17	523	23	0.48	24	4.61	3%	0.48 - 24	GW-80BR	NS	--	NS	--	93	0	RSL	0.0%
2-Nitrophenol	ug/L	540	23	517	23	0.12	150	27.1	4%	0.12 - 150	MP-1 #01	NS	--	NS	--	NS	--		
3 & 4 Methylphenol	ug/L	538	21	517	25	0.19	30	7.83	4%	0.19 - 30	GW-80BR	NS	--	NS	--	NS	--		
4,6-Dinitro-2-methylphenol	ug/L	465	2	463	98	1.1	1.1	1.1	0%	1.1 - 1.1	GW-66D; GW-71S	NS	--	NS	--	0.15	2	RSL	0.4%
4-Bromophenyl-phenylether	ug/L	563	10	553	0	0.5	4.1	1.77	2%	0.5 - 4.1	MP-1 #06	NS	--	NS	--	NS	--		
4-Chloroaniline	ug/L	562	1	561	1	0.85	0.85	0.85	0%	0.85 - 0.85	GW-45D	NS	--	NS	--	0.37	1	RSL	0.2%
4-Chlorophenyl-phenylether	ug/L	563	4	559	0	0.11	1.7	0.642	1%	0.11 - 1.7	GW-69D	NS	--	NS	--	NS	--		

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												Value	# Exceed	Value	# Exceed	Value	# Exceed		
4-Nitroaniline	ug/L	562	2	560	1	0.45	0.61	0.53	0%	0.45 - 0.61	GW-71S	NS	--	NS	--	3.8	0	RSL	0.0%
4-Nitrophenol	ug/L	523	21	502	33	0.76	58	18.1	4%	0.76 - 58	MP-1 #01	NS	--	NS	--	NS	--		
Acenaphthene	ug/L	563	4	559	0	0.034	0.13	0.0698	1%	0.034 - 0.13	GW-414BR	NS	--	NS	--	53	0	RSL	0.0%
Acenaphthylene	ug/L	563	2	561	0	0.065	0.09	0.0775	0%	0.065 - 0.09	GW-80D	NS	--	NS	--	NS	--		
Acetophenone	ug/L	563	18	545	0	0.63	11	4.04	3%	0.63 - 11	MP-1 #01	NS	--	NS	--	190	0	RSL	0.0%
Aniline	ug/L	560	6	554	3	0.68	1.1	0.967	1%	0.68 - 1.1	B-10 ... GW-82D (3 max locations)	NS	--	NS	--	13	0	RSL	0.0%
Anthracene	ug/L	563	6	557	0	0.041	0.36	0.136	1%	0.041 - 0.36	GW-414BR	NS	--	NS	--	180	0	RSL	0.0%
Atrazine	ug/L	563	1	562	0	0.94	0.94	0.94	0%	0.94 - 0.94	GW-71S	3	0	NS	--	0.3	1	MCL	0.0%
Azobenzene	ug/L	562	4	558	1	0.57	3.1	1.31	1%	0.57 - 3.1	MP-1 #06	NS	--	NS	--	0.12	4	RSL	0.7%
Benzaldehyde	ug/L	563	17	546	0	0.096	20	4.88	3%	0.096 - 20	GW-80BR	NS	--	NS	--	19	1	RSL	0.2%
Benzo(a)anthracene	ug/L	563	16	547	0	0.037	1.1	0.293	3%	0.037 - 1.1	GW-80S	NS	--	NS	--	0.03	16	RSL	2.8%
Benzo(a)pyrene	ug/L	563	28	535	0	0.094	1.2	0.226	5%	0.094 - 1.2	GW-80S	0.2	9	NS	--	0.025	28	MCL	1.6%
Benzo(b)fluoranthene	ug/L	563	20	543	0	0.13	1.7	0.374	4%	0.13 - 1.7	GW-80S	NS	--	NS	--	0.25	8	RSL	1.4%
Benzo(g,h,i)perylene	ug/L	563	24	539	0	0.092	0.82	0.245	4%	0.092 - 0.82	GW-80S	NS	--	NS	--	NS	--		
Benzo(k)fluoranthene	ug/L	563	14	549	0	0.13	0.61	0.26	2%	0.13 - 0.61	GW-80S	NS	--	NS	--	2.5	0	RSL	0.0%
Benzoic Acid	ug/L	413	59	354	138	0.57	46	3.62	14%	0.57 - 46	GW-80BR	NS	--	NS	--	7500	0	RSL	0.0%
Benzophenone	ug/L	563	49	514	0	0.078	56	4.1	9%	0.078 - 56	GW-6D	NS	--	NS	--	NS	--		
Benzyl Alcohol	ug/L	563	10	553	0	0.46	6	2.24	2%	0.46 - 6	GW-44D	NS	--	NS	--	200	0	RSL	0.0%
Bis(2-ethylhexyl)phthalate	ug/L	629	95	534	0	0.41	200	5.1	15%	0.41 - 200	IW-13	6	7	NS	--	5.6	8	MCL	1.1%
Bisphenol A	ug/L	201	15	186	0	0.43	72	17.8	7%	0.43 - 72	GW-80BR	NS	--	NS	--	77	0	RSL	0.0%
Butylbenzylphthalate	ug/L	563	17	546	0	0.15	0.88	0.455	3%	0.15 - 0.88	GW-71S; M-24/L-63	NS	--	NS	--	16	0	RSL	0.0%
Caprolactam	ug/L	453	28	425	110	0.2	6.4	0.931	6%	0.2 - 6.4	GW-44D	NS	--	NS	--	990	0	RSL	0.0%
Carbazole	ug/L	563	3	560	0	0.55	1.5	0.87	1%	0.55 - 1.5	GW-71S	NS	--	NS	--	NS	--		
Chrysene	ug/L	563	18	545	0	0.094	1.5	0.377	3%	0.094 - 1.5	GW-80S	NS	--	NS	--	25	0	RSL	0.0%
Dibenz(a,h)anthracene	ug/L	563	29	534	0	0.059	0.54	0.172	5%	0.059 - 0.54	GW-80D	NS	--	NS	--	0.025	29	RSL	***5.2%***
Diethylphthalate	ug/L	563	23	540	0	0.065	2.8	0.978	4%	0.065 - 2.8	GW-65BRDS	NS	--	NS	--	1500	0	RSL	0.0%
Dimethylphthalate	ug/L	563	3	560	0	0.061	0.53	0.36	1%	0.061 - 0.53	GW-83D	NS	--	NS	--	NS	--		
Di-N-Butylphthalate	ug/L	563	31	532	0	0.35	1.6	0.728	6%	0.35 - 1.6	M-27/L-14C	NS	--	NS	--	90	0	RSL	0.0%
Di-N-Octyl Phthalate	ug/L	563	1	562	0	0.46	0.46	0.46	0%	0.46 - 0.46	GW-400M	NS	--	NS	--	20	0	RSL	0.0%
Diphenyl ether	ug/L	563	103	460	0	0.51	260	13.7	18%	0.51 - 260	GW-15	NS	--	NS	--	NS	--		
Diphenylamine	ug/L	199	13	186	0	0.49	67	6.67	7%	0.49 - 67	GW-101	NS	--	NS	--	130	0	RSL	0.0%
Fluoranthene	ug/L	563	25	538	0	0.084	2.4	0.513	4%	0.084 - 2.4	GW-80S	NS	--	NS	--	80	0	RSL	0.0%
Fluorene	ug/L	563	9	554	0	0.063	0.2	0.103	2%	0.063 - 0.2	GW-414BR	NS	--	NS	--	29	0	RSL	0.0%
Indeno(1,2,3-cd)pyrene	ug/L	563	29	534	0	0.078	0.93	0.247	5%	0.078 - 0.93	GW-80D	NS	--	NS	--	0.25	9	RSL	1.6%
Isophorone	ug/L	562	5	557	1	0.26	0.36	0.296	1%	0.26 - 0.36	M-24/L-94	NS	--	NS	--	78	0	RSL	0.0%
Naphthalene, 1-methyl-	ug/L	563	7	556	0	0.045	0.24	0.111	1%	0.045 - 0.24	GW-80S	NS	--	NS	--	1.1	0	RSL	0.0%

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												Value	# Exceed	Value	# Exceed	Value	# Exceed		
N-Nitrosodimethylamine (NDMA)	ng/L	811	314	497	2	0.236	25000	828	39%	0.236 - 25000	GW-44D; MP-3 #01	NS	--	NS	--	0.11	314	RSL	***38.7%***
n-Nitrosodi-N-butylamine	ug/L	2	1	1	0	0.0049	0.0049	0.0049	50%	0.0049 - 0.0049	GW-10DR	NS	--	NS	--	0.0027	1	RSL	***50.0%***
N-Nitroso-di-n-propylamine (NDPA)	ng/L	799	26	773	0	0.49	5.3	1.83	3%	0.49 - 5.3	M-24/L-66	NS	--	NS	--	11	0	RSL	0.0%
N-Nitrosodiphenylamine	ug/L	625	97	528	0	0.26	360	61.2	16%	0.26 - 360	GW-16R	NS	--	NS	--	12	38	RSL	***6.1%***
N-nitrosomethyl-ethylamine	ug/L	2	1	1	0	0.0005	0.0005	0.0005	50%	0.0005 - 0.0005	GW-10DR	NS	--	NS	--	0.00071	0	RSL	0.0%
Nonylphenol	ug/L	201	63	138	0	1.6	38	10.3	31%	1.6 - 38	GW-202S	NS	--	NS	--	NS	--		
Nonylphenol Diethoxylate	ug/L	201	4	197	0	3.2	45	16.6	2%	3.2 - 45	GW-405BRD	NS	--	NS	--	NS	--		
Pentachlorophenol	ug/L	508	2	506	55	0.94	3.4	2.17	0%	0.94 - 3.4	GW-405BRD	1	1	NS	--	0.041	2	MCL	0.2%
Phenanthrene	ug/L	563	32	531	0	0.06	1.5	0.232	6%	0.06 - 1.5	GW-414BR	NS	--	NS	--	NS	--		
Phenol	ug/L	535	32	503	28	0.11	530	67.7	6%	0.11 - 530	MP-1 #01	NS	--	NS	--	580	0	RSL	0.0%
Phenol, 4-(1,1,3,3-Tetramethylbutyl)-	ug/L	201	4	197	0	20	36	25.8	2%	20 - 36	GW-80BR	NS	--	NS	--	NS	--		
Pyrene	ug/L	563	21	542	0	0.11	2.5	0.483	4%	0.11 - 2.5	GW-80S	NS	--	NS	--	12	0	RSL	0.0%
Pesticides/PCBs																			
Aroclor 1242	ug/L	36	1	35	0	0.2	0.2	0.2	3%	0.2 - 0.2	GW-413BR	NS	--	NS	--	0.0078	1	RSL	2.8%
Metals and Cyanide																			
Aluminum	ug/L	456	311	145	0	14	1900000	48000	***68%***	14 - 1900000	MP-2 #01	NS	--	200	121	2000	45	SMCL	***26.5%***
Antimony	ug/L	381	20	361	0	1.5	15	3.56	5%	1.5 - 15	GW-84D	6	2	NS	--	0.78	20	MCL	0.5%
Arsenic	ug/L	381	191	190	0	0.12	260	13.3	***50%***	0.12 - 260	MP-3 #01	10	43	NS	--	0.052	191	MCL	***11.3%***
Barium	ug/L	381	362	19	0	3.5	1500	50.8	***95%***	3.5 - 1500	BR-1	2000	0	NS	--	380	2	MCL	0.0%
Beryllium	ug/L	381	47	334	0	0.19	210	21.5	12%	0.19 - 210	MP-3 #01	4	12	NS	--	2.5	14	MCL	3.1%
Cadmium	ug/L	381	67	314	0	0.14	200	10.3	18%	0.14 - 200	MP-1 #01	5	12	NS	--	0.92	28	MCL	3.1%
Calcium	mg/L	556	556	0	0	0.78	680	111	***100%***	0.78 - 680	MP-4 #03	NS	--	NS	--	NS	--		
Chromium	ug/L	778	252	526	0	0.55	2000000	39900	32%	0.55 - 2000000	MP-2 #01	100	51	NS	--	2200	34	MCL	***6.6%***
Chromium-Hexavalent	ug/L	368	38	330	6	0.45	37000	977	10%	0.45 - 37000	BR-1	NS	--	NS	--	0.035	38	RSL	***10.3%***
Cobalt	ug/L	381	186	195	0	0.72	12000	400	49%	0.72 - 12000	MP-1 #01	NS	--	NS	--	0.6	186	RSL	***48.8%***
Copper	ug/L	381	74	307	0	1.7	9700	690	19%	1.7 - 9700	MP-1 #01	1300	8	1000	8	80	15	MCL	2.1%
Iron	ug/L	486	425	61	0	14	3300000	78600	***87%***	14 - 3300000	MP-1 #01	NS	--	300	290	1400	215	SMCL	***59.7%***
Lead	ug/L	381	51	330	0	1.3	34	4.05	13%	1.3 - 34	GW-45D	15	3	NS	--	15	3	MCL	0.8%
Magnesium	mg/L	404	399	5	0	0.11	1600	51.3	***99%***	0.11 - 1600	MP-1 #01	NS	--	NS	--	NS	--		
Manganese	ug/L	433	420	13	0	1.2	250000	7240	***97%***	1.2 - 250000	GW-70D; MP-1 #01	NS	--	50	350	43	354	SMCL	***80.8%***
Mercury	ug/L	381	33	348	0	0.06	3.1	0.345	9%	0.06 - 3.1	MP-1 #01	2	2	NS	--	0.063	32	MCL	0.5%
Nickel	ug/L	433	218	215	0	1.2	9900	284	***50%***	1.2 - 9900	MP-1 #01	NS	--	NS	--	39	35	RSL	***8.1%***
Potassium	ug/L	381	308	73	0	570	2200000	28700	***81%***	570 - 2200000	BR-1	NS	--	NS	--	NS	--		
Selenium	ug/L	381	9	372	0	3.2	7.3	4.94	2%	3.2 - 7.3	GW-71D	50	0	NS	--	10	0	MCL	0.0%
Silver	ug/L	381	17	364	0	2	32000	5230	4%	2 - 32000	MP-1 #01	NS	--	100	8	9.4	14	SMCL	2.1%
Sodium	mg/L	778	778	0	0	0.85	27000	353	***100%***	0.85 - 27000	MP-1 #01	NS	--	250	89	NS	--	SMCL	***11.4%***

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												Value	# Exceed	Value	# Exceed	Value	# Exceed		
Thallium	ug/L	381	18	363	0	0.12	5.8	0.928	5%	0.12 - 5.8	GW-45D	2	2	NS	--	0.02	18	MCL	0.5%
Tin	ug/L	381	15	366	0	7	890000	60900	4%	7 - 890000	MP-1 #01	NS	--	NS	--	1200	3	RSL	0.8%
Vanadium	ug/L	381	112	269	0	1.3	280	14.3	29%	1.3 - 280	GW-52S	NS	--	NS	--	8.6	21	RSL	***5.5%***
Zinc	ug/L	381	156	225	0	1.6	25000	1170	41%	1.6 - 25000	GW-202BRS	NS	--	5000	11	600	21	SMCL	2.9%
Dissolved Metals and Cyanide																			
Aluminum	ug/L	438	132	306	0	13	1900000	35700	30%	13 - 1900000	MP-2 #01	NS	--	200	77	2000	45	SMCL	***17.6%***
Arsenic	ug/L	10	5	5	0	2.7	7.3	5.24	50%	2.7 - 7.3	GW-31D	10	0	NS	--	0.052	5	MCL	0.0%
Barium	ug/L	10	10	0	0	5	120	33	***100%***	5 - 120	GW-307	2000	0	NS	--	380	0	MCL	0.0%
Beryllium	ug/L	10	4	6	0	0.17	12	3.24	40%	0.17 - 12	GW-202BRS	4	1	NS	--	2.5	1	MCL	***10.0%***
Cadmium	ug/L	10	2	8	0	0.19	11	5.6	20%	0.19 - 11	GW-202BRS	5	1	NS	--	0.92	1	MCL	***10.0%***
Calcium	mg/L	32	32	0	0	1.8	600	212	***100%***	1.8 - 600	MP-1 #01	NS	--	NS	--	NS	--		
Chromium	ug/L	438	403	35	0	1.1	2300000	10800	***92%***	1.1 - 2300000	MP-2 #01	100	44	NS	--	2200	9	MCL	***10.0%***
Cobalt	ug/L	10	8	2	0	1.7	710	113	***80%***	1.7 - 710	GW-202BRS	NS	--	NS	--	0.6	8	RSL	***80.0%***
Copper	ug/L	10	1	9	0	210	210	210	10%	210 - 210	GW-202BRS	1300	0	1000	0	80	1	MCL	0.0%
Iron	ug/L	95	84	11	0	17	2900000	95700	***88%***	17 - 2900000	MP-1 #01	NS	--	300	71	1400	64	SMCL	***74.7%***
Magnesium	mg/L	29	29	0	0	0.36	1600	176	***100%***	0.36 - 1600	MP-1 #01	NS	--	NS	--	NS	--		
Manganese	ug/L	13	13	0	0	11	22000	3260	***100%***	11 - 22000	GW-202BRS	NS	--	50	12	43	12	SMCL	***92.3%***
Mercury	ug/L	10	3	7	0	0.06	0.14	0.09	30%	0.06 - 0.14	GW-202BRD	2	0	NS	--	0.063	2	MCL	0.0%
Nickel	ug/L	13	9	4	0	1.5	740	104	***69%***	1.5 - 740	GW-202BRS	NS	--	NS	--	39	3	RSL	***23.1%***
Potassium	ug/L	10	7	3	0	780	38000	10800	***70%***	780 - 38000	GW-202BRS	NS	--	NS	--	NS	--		
Silver	ug/L	10	2	8	0	4.2	380	192	20%	4.2 - 380	GW-202BRS	NS	--	100	1	9.4	1	SMCL	***10.0%***
Sodium	mg/L	32	32	0	0	12	22000	1940	***100%***	12 - 22000	MP-1 #01	NS	--	250	18	NS	--	SMCL	***56.3%***
Thallium	ug/L	10	1	9	0	1.3	1.3	1.3	10%	1.3 - 1.3	GW-202BRS	2	0	NS	--	0.02	1	MCL	0.0%
Vanadium	ug/L	10	4	6	0	1.5	18	10.5	40%	1.5 - 18	GW-15; GW-307	NS	--	NS	--	8.6	2	RSL	***20.0%***
Zinc	ug/L	10	6	4	0	45	23000	6400	***60%***	45 - 23000	GW-202BRS	NS	--	5000	2	600	2	SMCL	***20.0%***
General Chemistry																			
Alkalinity, Bicarbonate (as CaCO3)	mg/L	44	44	0	0	8.8	410	130	***100%***	8.8 - 410	SL-3	NS	--	NS	--	NS	--		
Alkalinity, Total (as CaCO3)	mg/L	20	20	0	0	15	410	145	***100%***	15 - 410	SL-3	NS	--	NS	--	NS	--		
Ammonia	mg/L	199	193	6	0	0.11	360	47.2	***97%***	0.11 - 360	PZ-18R	NS	--	NS	--	NS	--		
Bromide	mg/L	380	160	220	1	0.075	32	1.53	42%	0.075 - 32	GW-44D	NS	--	NS	--	NS	--		
Chloride	mg/L	1202	1194	8	0	0.38	17000	293	***99%***	0.38 - 17000	MP-1 #01	NS	--	250	184	NS	--	SMCL	***15.3%***
Nitrate	mg/L	714	448	266	1	0.017	38	1.91	***63%***	0.017 - 38	GW-304	10	15	NS	--	3.2	66	MCL	2.1%
Nitrate as Nitrogen	mg/L	5	4	1	0	0.12	0.25	0.21	***80%***	0.12 - 0.25	BUTTERS ROW 2	NS	--	NS	--	NS	--		
Nitrite	mg/L	713	23	690	2	0.01	1	0.19	3%	0.01 - 1	MP-4 #02	1	0	NS	--	0.2	6	MCL	0.0%
Nitrogen, As Ammonia	mg/L	1019	656	363	1	0.009	10000	400	***64%***	0.009 - 10000	EW-1	NS	--	NS	--	NS	--		
pH	S.U.	62	62	0	0	5.17	7.99	6.47	***100%***	5.17 - 7.99	IW-10	NS	--	NS	--	NS	--		
Phthalic acid	ug/L	14	13	1	0	41	2400	363	***93%***	41 - 2400	BR-1	NS	--	NS	--	NS	--		

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												Value	# Exceed	Value	# Exceed	Value	# Exceed		
Phthalic Acid/Phthalic anhydride	ug/L	188	18	170	1	0.86	10	2.67	10%	0.86 - 10	BR-1	NS	--	NS	--	NS	--		
Specific Conductance	umhos/cm	406	406	0	0	56	6800	1470	***100%***	56 - 6800	PZ-18R	NS	--	NS	--	NS	--		
Specific Gravity	NA	42	42	0	0	0.972	1.25	1.02	***100%***	0.972 - 1.25	MP-2 #04	NS	--	NS	--	NS	--		
Sulfate	mg/L	1202	1185	17	0	1.2	100000	1110	***99%***	1.2 - 100000	MP-1 #01	NS	--	250	393	NS	--	SMCL	***32.7%***
Total Dissolved Solids	mg/L	25	25	0	0	34	1600	736	***100%***	34 - 1600	SL-5	NS	--	500	14	NS	--	SMCL	***56.0%***
Dissolved General Chemistry																			
Total Dissolved Solids	ug/L	23	23	0	0	60000	1900000	854000	***100%***	60000 - 1900000	SL-5; SL-6	NS	--	500000	14	NS	--	SMCL	***60.9%***
Extractable Petroleum Hydrocarbons																			
C11-C22 Aromatics	ug/L	8	5	3	0	120	430	224	***63%***	120 - 430	B-10	NS	--	NS	--	NS	--		
C11-C22 Aromatics (unadjusted)	ug/L	26	5	21	0	120	430	224	19%	120 - 430	B-10	NS	--	NS	--	NS	--		
C19-C36 Aliphatics	ug/L	26	7	19	0	10	35	19.6	27%	10 - 35	GW-85D	NS	--	NS	--	NS	--		
Extractable Petroleum Hydrocarbons, Total	ug/L	8	5	3	0	120	430	224	***63%***	120 - 430	B-10	NS	--	NS	--	NS	--		
Other Analyses																			
1,1-Dimethylhydrazine	ug/L	255	3	252	0	0.41	63	21.4	1%	0.41 - 63	MP-1 #01	NS	--	NS	--	0.00042	3	RSL	1.2%
Acetaldehyde	ug/L	253	7	246	0	13	75	38.6	3%	13 - 75	MP-3 #01	NS	--	NS	--	1.9	7	RSL	2.8%
Dimethylformamide	ug/L	183	16	167	0	5.8	380	91.3	9%	5.8 - 380	GW-80BR	NS	--	NS	--	6.1	15	RSL	***8.2%***
Formaldehyde	ug/L	253	36	217	0	5.1	2400	264	14%	5.1 - 2400	MP-3 #01	NS	--	NS	--	0.43	36	RSL	***14.2%***
Hydrazine	ug/L	255	32	223	0	0.054	230	11.3	13%	0.054 - 230	GW-307	NS	--	NS	--	0.0011	32	RSL	***12.5%***
Kempore (Azodicarbonamide)	ug/L	178	11	167	1	250	5200	1100	6%	250 - 5200	SL-6	NS	--	NS	--	NS	--		
Methylhydrazine	ug/L	255	1	254	0	0.31	0.31	0.31	0%	0.31 - 0.31	GW-307	NS	--	NS	--	0.0042	1	RSL	0.4%
Opex	ug/L	178	11	167	1	29	280	106	6%	29 - 280	GW-83D; GW-87D	NS	--	NS	--	NS	--		
Perchlorate	ug/L	18	2	16	0	1.7	1.8	1.75	11%	1.7 - 1.8	BR-1	NS	--	NS	--	NS	--		
Perchlorate (organic)	ug/L	183	18	165	0	0.21	14	5.47	10%	0.21 - 14	GW-44D; MP-3 #01	15	0	NS	--	1.4	11	MCL	0.0%
Volatile Petroleum Hydrocarbons																			
Benzene	ug/L	71	14	57	0	0.33	3.4	2.36	20%	0.33 - 3.4	GW-16R	5	0	NS	--	0.46	13	MCL	0.0%
C5-C8 Aliphatics	ug/L	80	55	25	0	1.8	2100	781	***69%***	1.8 - 2100	GW-16R	NS	--	NS	--	NS	--		
C5-C8 Aliphatics (unadjusted)	ug/L	89	62	27	0	1.8	2200	710	***70%***	1.8 - 2200	GW-16R	NS	--	NS	--	NS	--		
C9-C10 Aromatics	ug/L	62	13	49	0	0.54	64	17.5	21%	0.54 - 64	GW-16R	NS	--	NS	--	NS	--		
C9-C10 Aromatics (unadj.)	ug/L	36	16	20	0	0.6	24	6.83	44%	0.6 - 24	GW-16R	NS	--	NS	--	NS	--		
C9-C12 Aliphatics	ug/L	89	23	66	0	1.7	150	38.4	26%	1.7 - 150	GW-16R	NS	--	NS	--	NS	--		
C9-C12 Aliphatics (unadjusted)	ug/L	89	30	59	0	1.7	170	48.3	34%	1.7 - 170	GW-16R	NS	--	NS	--	NS	--		
Ethylbenzene	ug/L	71	14	57	0	0.35	5.2	2.57	20%	0.35 - 5.2	GW-16R	700	0	NS	--	1.5	10	MCL	0.0%
m,p-Xylene	ug/L	71	1	70	0	1.7	1.7	1.7	1%	1.7 - 1.7	B-03	10000	0	NS	--	19	0	MCL	0.0%
Methyl tert-butyl ether	ug/L	71	12	59	0	0.32	71	12.7	17%	0.32 - 71	GW-16R	NS	--	NS	--	14	3	RSL	4.2%
Naphthalene	ug/L	71	1	70	0	9.8	9.8	9.8	1%	9.8 - 9.8	GW-16R	NS	--	NS	--	0.17	1	RSL	1.4%
o-Xylene	ug/L	70	12	58	0	0.31	13	5.32	17%	0.31 - 13	IW-6	10000	0	NS	--	19	0	MCL	0.0%

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												Value	# Exceed	Value	# Exceed	Value	# Exceed		
Toluene	ug/L	71	19	52	0	0.58	55	14.3	27%	0.58 - 55	GW-16R	1000	0	NS	--	110	0	MCL	0.0%
Volatile Petroleum Hydrocarbons, Total	ug/L	28	16	12	0	170	1700	1190	***57%***	170 - 1700	GW-16R	NS	--	NS	--	NS	--		

Notes:

RSL = June 2017 Tapwater Regional Screening Levels; MCL = groundwater maximum contaminant level; SMCL = secondary maximum contaminant contaminant level; NS - No Standard; -- Not Applicable

Color - Standard Exceeded

Applicable standard ranking: MCL, then SMCL if no MCL available, then RSL if no MCL or SMCL available.

Analytes detected in more than50% of samples analyzed or that exceed the applicable screening criteria in more than 5% of samples analyzed are in ***bold italics***.

APPENDIX 2

EPA Comments on Draft Remedial Investigation Report, Operable Unit 3 (March 30, 2018) as supplemented by a memorandum entitled, *Containment Area Bedrock Boring Results, Olin Chemical Superfund Site (OCSS) in Wilmington MA (Site), May 10, 2018* Olin Chemical Superfund Site, Wilmington, Massachusetts

A Memorandum entitled, *Containment Area Bedrock Boring Results, Olin Chemical Superfund Site (OCSS) in Wilmington MA (Site), May 10, 2018* was prepared by Wood and subsequently transmitted via cover letter to EPA on May 10, 2018.

This memorandum summarizes the installation of two bedrock borings in the containment area (1 within, 1 just outside) to evaluate the integrity of bedrock in this area. The purpose of the work, stated in the *Summary of Work Performed*, is, "to collect additional information and to verify the nature of the bedrock underlying the Containment Area and the associated DAPL pool at the Site," yet only one of the two borings drilled for the effort were advanced in the area directly beneath the containment area itself. As such, firm sweeping conclusions regarding the nature of the bedrock in this area are difficult to support.

Based on EPA's evaluation of all data available for the containment area, EPA is unable to concur with Olin's conclusion (from the executive summary) that, "*the bedrock underlying the Containment Area is highly competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity*." This conclusion, which EPA has called into question previously due to lack of supporting information, remains an unproven opinion. As demonstrated in the comments below, the investigation failed to characterize key areas of the bedrock beneath this area, including areas where there is a high probability of fracturing. Moreover, EPA interpretations of the currently available data suggest that fracture connectivity between the sub-containment area bedrock and known and/or undiscovered fractures likely exist.

GENERAL COMMENTS

1. The study and its conclusions are rejected. The reasons are numerous and are discussed more fully in the comments, below. The design was unilaterally developed by Olin and its consultant, Wood, in the absence of regulatory input and/or *in conflict with* previously supplied comments and suggestions. The study and its conclusions are critically flawed. Additional technical input would have resulted in a more robust design with meaningful conclusions. For the technical reasons provided in the analyses discussed below, EPA rejects the conclusions of this effort. The Draft OU3 RI Report ("RI Report") shall be revised to include the analysis provided by EPA in comments below and conclude that the bedrock beneath the containment area is not competent and that fracture connectivity between the sub-containment area bedrock and known and/or undiscovered fractures likely exists. Furthermore, while the comments below provide recommendations for additional targeted work, this work is only needed to refine EPA's conceptual site model ("CSM") by providing better information on the locations and extent of fractures, not to demonstrate competency of the bedrock. EPA believes that this information, as well as other information contained in the RI Report and further discussed in comments on the RI

Report, strongly supports the need for the development of a Feasibility Study with robust source control alternatives for this area.

2. EPA's analysis suggests that there are at least 3 primary fracture orientations present at the site-scale which have strong potential to influence contaminant distribution and migration within the bedrock beneath and peripheral to the containment area. These include the following:
   - Sub-horizontal to shallowly-dipping "sheeting" fractures;
   - Northeast-striking fractures - Moderate to Steeply dipping (to NW); and
   - Northwest-striking fractures - Steeply dipping to sub-vertical.

   The characteristics, relevance, and importance of each of these fracture sets are discussed in separate comments below, emphasizing the issues of bedrock nature, composition and competency relative to the robustness of the interpreted "containment" properties of the bedrock immediately underlying the containment area. It should be noted that each of these three major classes of fracture types discussed above are represented in each of the borings OC-BB-1-2108 and OC-BB-2-2108. Summary tables for each of these boreholes are included below as specific comments.

   Sub-horizontal to shallowly-dipping sheeting fractures; These types of fractures are common in the shallow bedrock zone in glaciated terrains. While potentially present at greater depths, shallowly-dipping fractures are commonly observed in the upper portions of the bedrock in the glaciated northeast U.S. In New England, these are most commonly observed in shallow regions to a depth of 100 feet or less into bedrock. Nobis' comment letter of May 21, 2018 identified this issue and noted numerous observations on the drilling logs for OC-BB-1-2018 and OC-BB-2-2018 consistent with this style of fracturing. This analysis confirms the potential importance of these shallow sub-horizontal fractures relative to contaminant transport within and potentially beyond the containment area. Since the containment wall is only installed to the top of the bedrock surface, it appears possible (if not likely) that lateral transport pathways utilizing shallow sub-horizontal fractures in the upper part of the bedrock may exist, and if so, are not impeded by the containment wall. Given the potential importance and likely presence of such features, the investigation should have targeted them. Rather, as noted in Nobis' comments, the investigation essentially avoided them by casing off the upper portion of bedrock with the notable exception of OC-BB-2-2018, which inadvertently exposed a large-aperture fracture with a shallow dip at 32.3 ft bgs. This fracture appears to be significant hydraulically, and is an excellent example of the larger class of sub-horizontal/shallowly-dipping sheeting fractures which likely exist over large areas of the containment area's subsurface. Similar features were noted on the drilling log for OC-BB-1-2018 but were cased-off, (as is appropriate), by the grouted steel casing. While OC-BB-1-2018 appears to be appropriately constructed to assess deeper rock, it is not suitable to assess shallow fracturing due to the grouted steel casing which seals off such features. OC-BB-2-2018 is suitable for neither as its failed casing installation essential creates potential for short-circuits which confound assessment and differentiation between shallow and deeper zones. After OC-BB-2-2018 is demonstrated to be plugged and abandoned in a verifiable manner, if future work is conducted, this work should be targeted towards deeper bedrock within the central portion of the containment area. In addition, future bedrock characterization efforts here and elsewhere on the Site need to take deliberate steps to characterize the uppermost shallow bedrock interval, utilizing methods which can identify and assess the presence and significance of these shallow sheeting fractures. Finally, in areas such as the central portions of the containment area or any other area where significant source material exists, double- or triple-casing installations or other specialized drilling approaches will need to be considered.

Northeast-striking fractures; The northeast-to-southwest strike is clearly the predominant orientation of the bedrock compositional layering (foliation) and associated fracturing. A large percentage of the hydraulically-significant fractures identified in boreholes seem to follow the foliation strike and dip to a significant degree. Dips of foliation layering as well as dips of foliation-parallel fractures appear to be relatively consistent to the northwest at steep to moderate angles. Because of these relatively steep dips, fracture information collected at one location is not necessarily relevant to other areas at relatively small distances normal to strike. As such, the current investigations, both at the containment area scale as well as the larger Site scale, have not fully assessed the stratigraphic variability which likely exists at the Site. Variations in rock composition may result in differences in fracture style and density as well as variations in primary and secondary porosity. It is not yet clear that all the primary fracture pathways which exploit the NE-SW fabric have yet been identified at the Site. This problem is most acute beneath the containment area.

Due to study design's failure to recognize the importance of stratigraphic dip angle, the investigation resulted in few new insights with regards to "competency" of bedrock beneath the bulk of the containment area. The detailed analysis EPA completed for this study suggests that several hundred feet of stratigraphic section beneath the containment area remain uncharacterized. OC-BB-1-2018 and OC-BB-2-2018 only assessed the margins of the containment area and Olin/Wood's efforts to "verify the nature of the bedrock underlying the Containment Area" remain unfulfilled. Potential impacts due to northeast striking fractures beneath the containment area remain unassessed.

The following comments provide additional detail as well as the technical basis for EPA's conclusions in this regard. Further assessments will be needed. Future investigations in the containment area and elsewhere at the site need to more carefully consider the steep to moderate dips of the NE-SW striking features.

Northwest-striking fractures - Steeply dipping; Steeply-dipping fractures of NW-SE strike are common in the northeast U.S. and are commonly of significant importance hydraulically. The steep dip angles, near vertical in many cases, however, make these difficult to intersect with randomly located bedrock boreholes. These difficulties notwithstanding, the available Site data suggests that such features are present across the site, and are therefore of potential importance and deserving of future focused efforts. The limited containment area study corroborates this. Both OC-BB-1-2018 and OC-BB-2-2018 intersected steeply dipping NW-SE striking fractures of potential hydraulic significance.

It is noted that in each of these boreholes, the steeply dipping NW-SE striking fractures can be projected upward into the containment area. While the strike length of these features is not known, specific features of this orientation intersected by OC-BB-1-2018 and OC-BB-2-2018 have at least the *potential* to "daylight" beneath the containment area, and may thus provide a pathway into bedrock.

This potential pathway needs to be further assessed. As recommended previously, favorably oriented surface geophysical surveys shall be employed to identify specific drilling targets for future phases of work. This is especially important for these types of steeply-dipping fractures. For example, lines oriented SW to NE are recommended along the northern and southern margins of the containment area to guide future drilling efforts targeted to additional NW-striking fractures which may underlie the containment area.

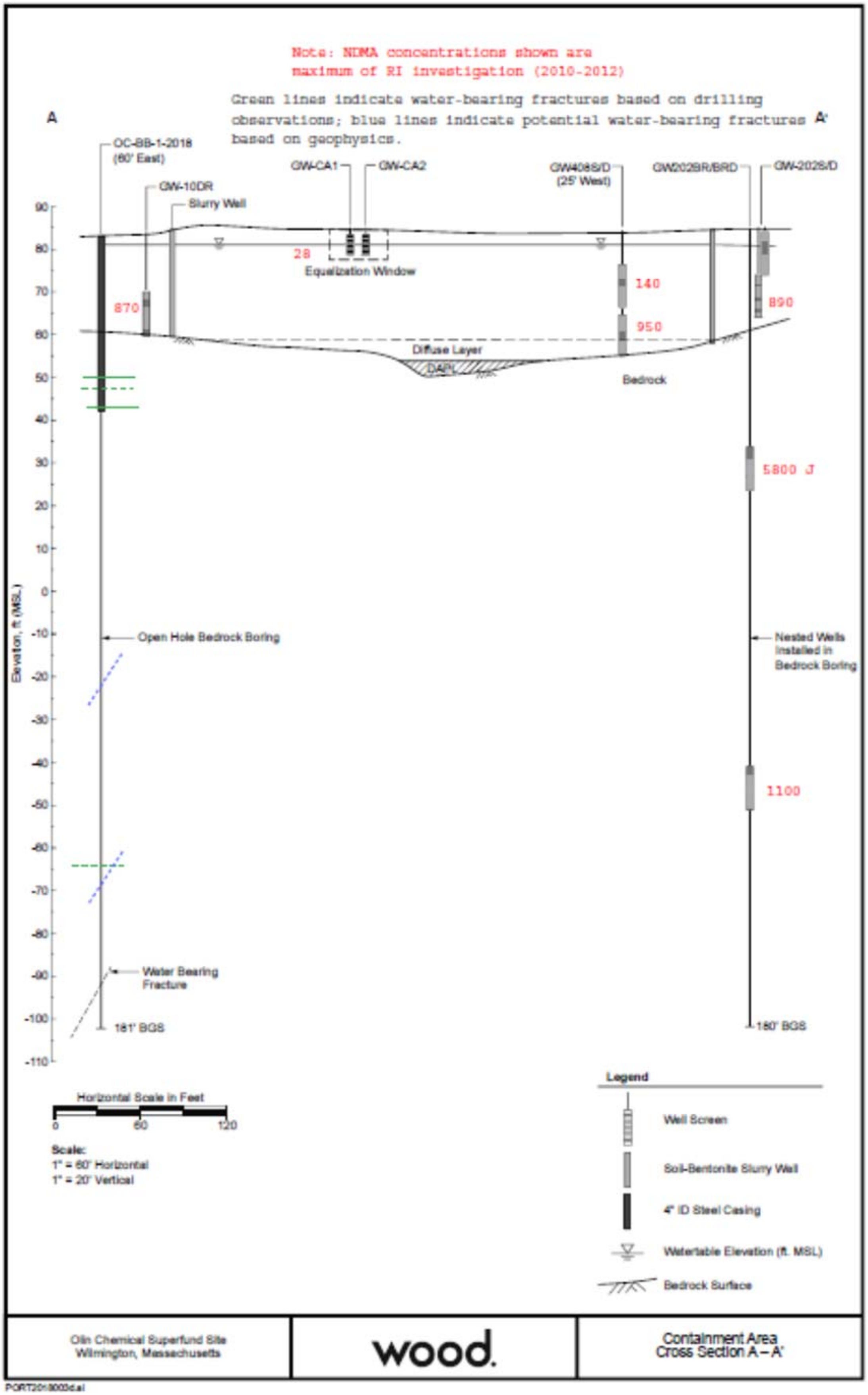
Sufficiency of the Characterization of Bedrock Integrity within and beneath the Containment Area; EPA is unable to concur with the report's central conclusion, i.e., that the "*bedrock underlying the Containment Area is highly competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity*." Rather, EPA believes the opposite conclusion is the simplest and best explanation for the current data. In summary, EPA's emerging conceptual model for the containment area includes the following elements, and the RI Report shall be revised to include this conceptual site model:

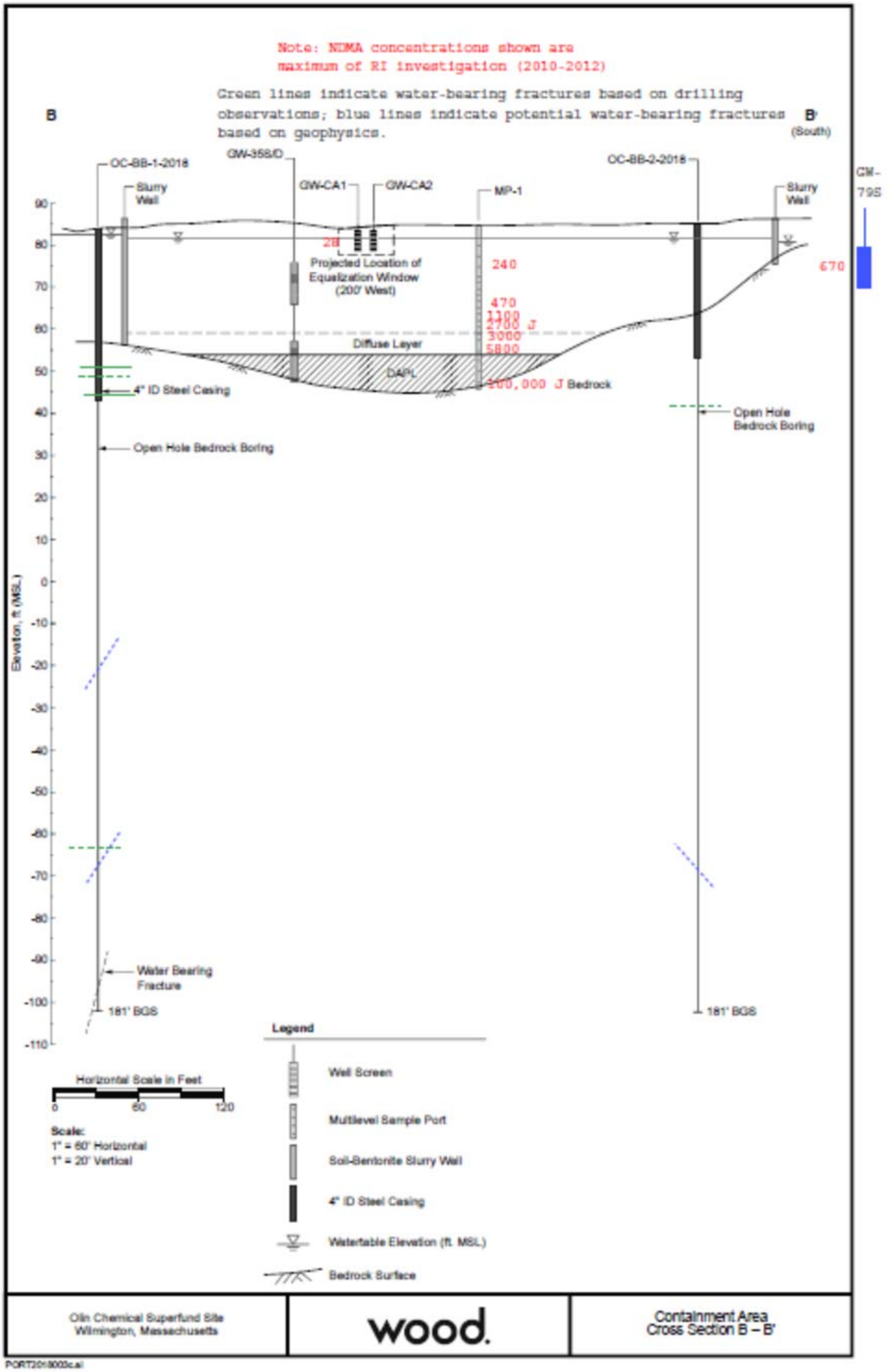
- The containment area is in the core/hinge of a tight fold in the metamorphic rocks.
- Geologically, such an area is more likely to have a higher fracture density than the limbs/flanks of such a fold.
- Cross sections A-A' and B-B' indicate a depression of lower elevation on the bedrock surface in the central portion of the containment area.
- This groove-like depression is oriented NE-SW, generally consistent with the regional strike and plunge of the fold axis.
- Such depressions on the bedrock surface are commonly associated with compositional variation in the bedrock (e.g., softer rock) and/or more fracturing, which both may have contributed to a greater amount of differential glacial scouring relative to adjacent areas (i.e., during the 'recent' Pleistocene glacial period).
- The extreme vertical exaggeration employed on Wood's hydrogeologic cross sections lead to misleading conclusions due to the distorted angular relationships and should not be used except with extreme caution for interpreting conditions beneath the containment area;
- EPA has prepared true-scale geologic cross sections with no vertical exaggeration which indicate that OC-BB-1-2018 and OC-BB-2-2018 have only characterized the margins of the containment area.
- Examination of the true-scale cross section with measured dip angles reveals the limits and ineffectiveness of the current investigation.
- Most of the rock mass beneath the containment area is essentially uncharacterized, amounting to roughly 350 of uncharacterized stratigraphic section.
- This data gap underlies the central portion of the containment area and the DAPL area, which as stated above is likely more heavily fractured than the peripheral areas.
- Even though they are located on the periphery of the containment area, OC-BB-1-2018 and OC-BB-2-2018 both intersected fractures which may project upward into the bedrock beneath the containment area.
- All three primary classes of fractures discussed above for the Site in general are represented in the data collected for OC-BB-1-2018 and OC-BB-2-2018, and depending on the strike lengths of specific features (which are not known presently), fractures penetrated by these borings have the possibility of intersecting/connecting with the interior of the containment area, including the DAPL area, with reasonable assumptions for strike and dip continuity.

3. Additional methods shall be employed to determine groundwater flow. The geophysical investigations in the deep bedrock in the area suggest that groundwater flow is low in this area. However, a more accurate representation of groundwater flow shall be obtained via hydraulic testing (such as packer testing or liner transmissivity tests).

4. The bedrock boring program did not include any analytical sample results. Given that location OC-BB-1-2018 is relatively close to the edge of the diffuse layer and DAPL pool, and that location OC-BB-2-2018 is located downgradient of the DAPL and diffuse layer (and upgradient of impacted location GW-79S), Olin shall collect groundwater samples to determine if bedrock is impacted and to confirm the CSM.

5. If the bedrock were competent close to the surface, this would suggest that the elevated concentrations of contaminants such as NDMA would be from other sources instead of the containment area. NDMA concentrations have been included on the figures below to illustrate this point. Therefore, a more appropriate evaluation would have involved shallow bedrock boreholes rather than casing through the shallow bedrock zone.


Note: NDMA concentrations shown are maximum of RI investigation (2010-2012)
Green lines indicate water-bearing fractures based on drilling observations; blue lines indicate potential water-bearing fractures based on geophysics.
A
A'
OC-BB-1-2018 (60' East)
GW-10DR
Slurry Wall
GW-CA1
GW-CA2
GW408S/D (25' West)
GW202BR/BRD
GW-202S/D
28
Equalization Window
870
140
950
890
Diffuse Layer
DAPL
Bedrock
5800 J
1100
Elevation, ft (MSL)
Open Hole Bedrock Boring
Nested Wells Installed in Bedrock Boring
Water Bearing Fracture
181' BGS
180' BGS
Horizontal Scale in Feet
0 60 120
Scale:
1" = 60' Horizontal
1" = 20' Vertical
Legend
Well Screen
Soil-Bentonite Slurry Wall
4" ID Steel Casing
Watertable Elevation (ft. MSL)
Bedrock Surface
Olin Chemical Superfund Site
Wilmington, Massachusetts
wood.
Containment Area
Cross Section A – A'
PORT2018003d.ai



Note: NDMA concentrations shown are maximum of RI investigation (2010-2012)
Green lines indicate water-bearing fractures based on drilling observations; blue lines indicate potential water-bearing fractures based on geophysics.
B
B'
(South)
OC-BB-1-2018
GW-358/D
OC-BB-2-2018
Slurry Wall
GW-CA1
GW-CA2
MP-1
Slurry Wall
GW-79S
28
Projected Location of Equalization Window (200' West)
240
470
1100
2700 J
3000
5800
670
Diffuse Layer
DAPL
100,000 J Bedrock
4" ID Steel Casing
Open Hole Bedrock Boring
Open Hole Bedrock Boring
Water Bearing Fracture
181' BGS
181' BGS
Elevation, ft (MSL)
Legend
Well Screen
Multilevel Sample Port
Soil-Bentonite Slurry Wall
4" ID Steel Casing
Watertable Elevation (ft. MSL)
Bedrock Surface
Horizontal Scale in Feet
0
60
120
Scale:
1" = 60' Horizontal
1" = 20' Vertical
Olin Chemical Superfund Site Wilmington, Massachusetts
wood.
Containment Area Cross Section B – B'
PORT2018003c.ai

6. During the hydraulic pulse interference test (HPIT) study conducted to evaluate the integrity of the slurry well, a hydraulic pulse was received during the GW-6D to GW-CA3D test. In their data review, Amec suggested that the pulse could have been transmitted under the slurry wall through weathered bedrock. GeoInsight did not agree with this unfounded assertion based upon the data provided. However, Olin now appears to suggest that the bedrock in the containment cell is competent, which contradicts their earlier assertion from the HPIT test review. Simply put, Olin cannot have it both ways. If Olin now wishes to assert that the bedrock beneath the containment area is competent, then the HPIT testing indicates a failure in the slurry wall that requires additional evaluation. EPA notes that for practical purposes, there is no point in distinguishing between "weathered bedrock" and "underlying bedrock" because the slurry wall was installed to the top of bedrock – not completely through the weathered bedrock zone. Ignoring the weathered bedrock zone, as Olin does in their investigation, results in an incomplete understanding of the integrity of the containment area.

7. WERC's comments on the Draft OU1 and OU2 FS Report provided an analysis of the water levels in and around the containment area. The analysis concluded the water level in the containment area has a consistent slope from north to south which reflects the groundwater outside the containment area. The containment area clearly is not functioning as designed. These findings indicate that a "tilt" of the internal water contours is occurring due to the influence of the outside water table. The north side is higher, and the south side is lower in the internal water table. So, the containment area is not isolated from the outside. Flow is occurring into the area from the north and out of the containment area in the south. The well boring construction information in this memo indicates the flow may be through the weathered bedrock surface or through the bedrock fractures in the upper layers.

8. MassDEP disagrees that monitoring well GW-202BR and BR-1 verify the competency of the bedrock. Both GW-202BR and BR-1 show Site-related contamination. The document shall be revised to discuss how the detections of contamination in these bedrock wells demonstrates that the bedrock is not competent.

SPECIFIC COMMENTS

1. Executive summary; Page 1, 3rd ¶; The text states "*The boring inside the Containment Area and immediately adjacent to the associated DAPL pool encountered un-fractured and highly competent bedrock over the entire borehole (to a depth of approximately 180 feet below ground surface (bgs). The boring outside the area had only one likely water bearing fracture, which was at a depth well below the DAPL (approximately 175 feet bgs). The borings corroborate the previous findings that bedrock underlying the Containment Area is highly competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity*." EPA is unable to concur with these sweeping but inaccurate conclusions as they lack technical support or are in some cases contrary to existing information, including data from the new boreholes. For example, a very significant fracture occurs at a 32.3 feet bgs in OC-BB-2-2018, just below the base of the steel casing. The fracture has a huge aperture (32 mm), which is the largest measured in either of the two borings, as well as a demonstrable relationship to flow based on pumped HPFM data. Clearly the generalization of "un-fractured" conditions "over the entire borehole" is not accurate. Similarly, the "*one likely water bearing fracture"* discussed relative to OC-BB-1-2018 (at 176.0 bgs) is not the *only* one identified on the geophysical logs.

While the fracture discussed here appears to be the largest and most significant with respect to flow, additional notable fractures were identified by Olin's geophysical contractor at 104.9, 106.3, 114.7, and 116.6 feet bgs, and drilling logs suggest the presence of additional potential fracture zones not detected by the geophysical surveys, particularly in the uppermost 70 feet of the borehole. While it is not clear what "previous findings" are supported by the current efforts, EPA disagrees with the statement that "*bedrock underlying the Containment Area is highly competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity*." The basis for EPA's position is presented in comments provided in this appendix as well as Appendix 1. Therefore, these statements must be deleted from the report and replaced with EPA's summary of the CSM for this area. In addition, EPA has provided comments suggesting further work needed that would help refine EPA's CSM for this area.

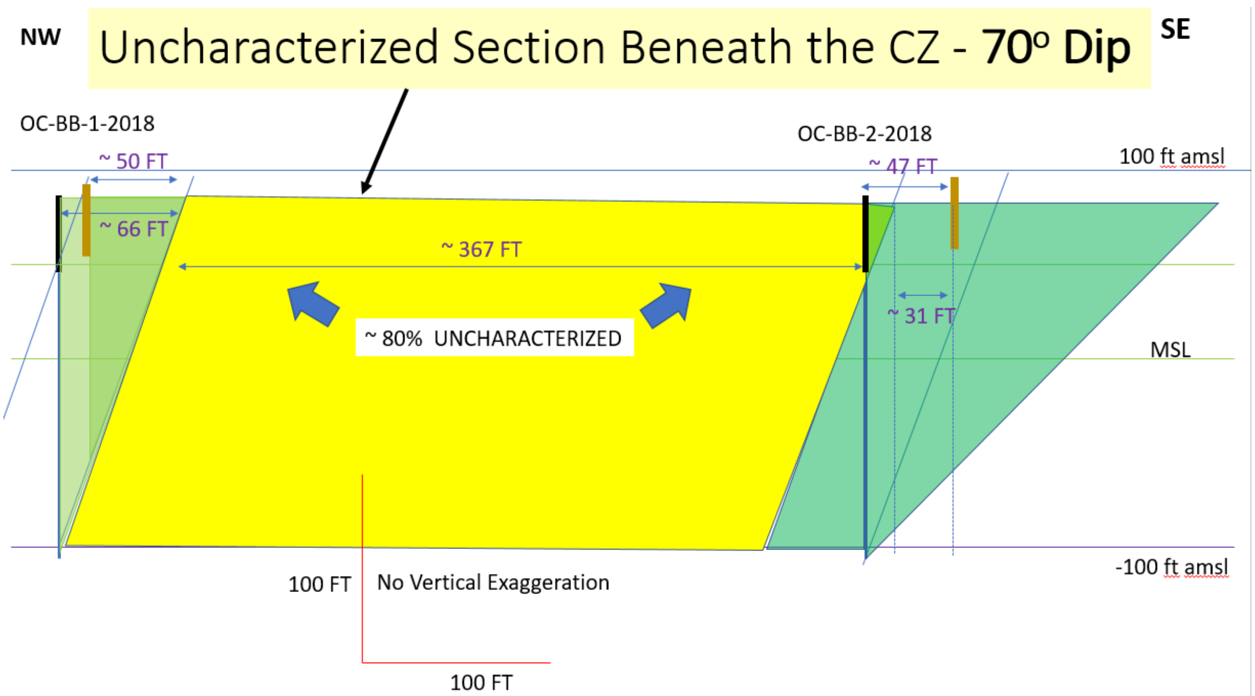
2. <u>Summary of Work Performed</u>, Page 1, 4th ¶; The text states, "*One boring, OC-BB-2-2018, was positioned along the geologic strike of the competent bedrock lithology encountered in GW-202BR to evaluate lateral geologic continuity of that lithology. The other boring OC-BB-1-2018 was completed perpendicular to geologic strike to evaluate thickness and down dip continuity of that lithology across the other side of the Containment Area*." This statement is misleading at best. While it is true that *OC-BB-2-2018* is generally on strike with GW-202BR, and it is also true that OC-BB-1-2018 is located generally perpendicular to strike in the down-dip direction, it is *false and misleading* to state that these two locations could *"evaluate thickness and downdip continuity of that lithology across the other side of the Containment area*." While the grossly vertically-exaggerated cross sections prepared by Wood could give such a false impression, a true-scale geologic cross section provides a vastly different story.

Even with the lack of data within the containment area itself, a true-scale cross section can be constructed perpendicular to strike to assess the adequacy of the down-dip characterization of the bedrock beneath the containment area in its simplest embodiment, as a mass of dipping layered rocks, (as Wood's generic characterization states), and the limited data available. However, the substantial vertical exaggeration in Wood's cross sections distort the true angular relationships, and interpretations made from this distorted perspective are fatally flawed. The following true-scale cross section presents a simplified version of the same information shown on Wood's B-B' cross section without vertical exaggeration. In other words, the horizontal scale is the same as the vertical. Assumed in this cross section is a consistent stratigraphic dip of 70 degrees across the area of interest. This assumption seems to be well justified based on the dips recorded in oriented logs from OC-BB-1-2018 and OC-BB-2-2018. Several important observations are immediately observed by inspection of this cross section, including the following:

- The full stratigraphic sequence across the containment area has not been fully assessed. In fact, approximately 350 feet of the stratigraphic sequence has not been assessed in any fashion. This is unacceptable as this interval is the zone directly beneath the heart of the containment area, in effect the 'sweet spot', which is the most critical towards evaluating the effectiveness of containment.
- The horizontal data gap, i.e., width along the general position of the top-of-bedrock surface, is on the order of 370 feet in the horizontal dimension, representing a lateral data gap on the order of a full-sized football field with large end zones. OC-BB-1-2018 and OC-BB-2-2018, at best, were only effective in assessing ~ 20 % of the stratigraphic section along this profile line*, at best*. The completeness of the characterization is even lower if one considers the third dimension.

- Since there has been effectively *no penetration* of the rocks beneath the central portion of the containment area subsurface, the fracture characteristics of this critical interval are unknown. It is *inappropriate* to assume that these rocks have the same characteristics as those penetrated by OC-BB-1-2018 and OC-BB-2-2018. Actual data is needed.

Note "CZ" in the figure below refers to containment zone or area.



3. *Page 2 and 3. Bedrock Boring Installation: OC-BB-2-2018* Olin states the following: *"The overburden soils were composed of sand with large amounts of gravel and cobbles – however, auger refusal was encountered at approximately 17 feet bgs in what appeared to be cobbles and boulders that included weathered bedrock. The six-inch air hammer was then used to clean out the casing and attempt to drill to competent rock. The borehole was quickly advanced, through cobbles, boulders, till, and weathered bedrock, to approximately 27 feet bgs where competent bedrock was encountered. The borehole was advanced to 30 feet bgs. Repeated attempts to clean out the borehole to 30 feet were unsuccessful due to cave in of material and approximately 6 feet of material could not be removed from the bottom of the borehole. The four-inch steel casing was hammered to refusal at 28 feet, and grout was tremied into the borehole annulus to attempt to seal off the casing from the overburden."*

In the construction of well OC-BB-2-2018, boulders and weathered bedrock were encountered at 17 bgs but the steel casing was carried through to a depth of 30 bgs. So, for this well, the casing went through 13 feet of bedrock before the rock was judged to be competent not to need a casing. The construction of this well also included cave-in. Again, this is not how the slurry wall was constructed for the Containment Area. For both wells, over 10 feet of bedrock had to have steel casing. This indicates the groundwater can easily flow under the slurry wall in the weathered and fractured upper layers of the bedrock.

4. _Borehole Geophysical Logging, Page 3 last para_.; *(OC-BB-1-2018);* The text states *"Overall, the bedrock is competent and the observed fractures are well below the bottom of the DAPL in the Containment Area (**Cross Section A-A'**)."* This statement is at odds with the facts. A compilation of measured or suspected fractures based on data provided in this memorandum is included below in table format. Numerous fractures were identified in all levels of the boring. Several fracture zones, likely to be shallowly dipping sheeting fractures where identified at 32 and 35.5 feet bgs, but were cased-off by the cemented steel casing. Moreover, the sole fracture Wood chose to include on Cross Section A-A' (numbered fracture 102) is the deepest, but far from the only fracture identified. Despite its depth and position near the bottom of the borehole, this fracture is clearly significant hydraulically and if projected up-dip, would appear to intersect the DAPL pool in the central part of the containment area

5. _Borehole Geophysical Logging, Page 4, 1st para_.; (OC-BB-2-2018); The text again concludes *"In general it appears that bedrock in OC-BB-2-2018 is un-fractured and highly competent over the entire borehole*." Again, this conclusion conflicts with the totality of the information contained in the memo. For example, the drilling logs noted "*possible fractures*" based on drilling response at 43, 58, and 115 ft bgs. The NW-striking fracture detected at 138.6 ft bgs has the potential to influence the containment area depending on its strike length. Clearly, the huge fracture identified at 32.3 ft bgs cannot be so easily dismissed. The report states, "*Although the composite log correctly identifies this as a "likely transmissive zone", it is not a fracture*." While the borehole may have been preferentially enlarged in this zone (by the drilling process) due to the presence of a fractured zone here, there is *no basis* for concluding that there is *not* a fracture here. Issues regarding the failed casing installation at this location have been summarized in a memo provided separately to Olin. In any case, EPA believes there is ample technical justification to conclude that the fracture at 32.3 ft bgs is "real", naturally-existing but enlarged due to the drilling process, _and_ the borehole is affected by leakage around the casing as confirmed by the text here, "*The OTV log clearly shows the separation between the steel casing and the bedrock surface within the bedrock socket.*" After this leaking casing situation is corrected, it will be necessary to reexamine this depth interval under more carefully controlled conditions to determine the true nature and extent of shallow fracturing here, and most importantly whether it may represent a pathway through/beneath/beyond the containment area.

*6. _Conclusions with Respect to Containment Area Conceptual Site Model_*: The text states that "*The recently installed borings corroborate the previous findings from GW-202BR and BR-1 that bedrock underlying the Containment Area is competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity."* This conclusion is unsupported and is rejected. In the comments above, EPA has presented a different CSM for the containment area which integrates a broader spectrum of data from a variety of sources not considered by Wood. Wood's interpretation has an unjustified bias for the ubiquitous presence of 'quartzite' as essentially the 'default' rock unit beneath the containment area, despite little to no real information beneath the containment area and conflicting information from other sources. For example, published geologic mapping (e.g., the large-scale bedrock geologic map presented at recent meetings) for the area shows the quartzite unit as only occupying a small portion of the containment area. Moreover, the unit is mapped as part of a well-defined fold hinge in the containment area. While the actual position of the quartzite layer within the containment area is not well constrained due to the limited data, it does appear to *generally* hold up the southern flank of the containment area. Previous field investigations identified diorite and gabbro as the primary rock type (not quartzite). However, even if this is true, Wood's interpretation stretches the data, "*OC-BB-2-2018 drilling and borehole geophysical logging supports a conclusion that the quartz rich lithology is laterally continuous along the south side of the on-Property DAPL pool*." On what basis is the unit determined to be ___continuous___? More importantly, Wood's CSM appears to hold an unjustified bias that quartzite units are essentially *unfractured*. There is no basis for this bias, and the facts appear to be contradictory to Wood's assertions. For example, the conclusions state:

> "*The orientation of fracture features is predominantly parallel to relict bedding (foliation) of the bedrock which strikes north easterly and dips moderately to steeply (50-80 degrees) toward the northwest. The direction of groundwater flow is from the northwest to the southeast, perpendicular to the orientation of bedrock foliation underlying the Containment Area. Fractures parallel to this groundwater flow direction do exist but are sparse and not generally correlated with identified transmissive zones. Therefore, the transmissivity across bedrock underlying the Containment Area in the direction of groundwater flow is expected to be extremely low and the fracture network, to the extent it exists, is not well connected*."

Again, this statement represents a selective application of the facts. As noted in the previous comments, both OC-BB-1-2018 and OC-BB-2-2018 both intersected NW-striking steeply dipping fractures *that the geophysical subcontractor designated as noteworthy*. For each of these boreholes, if projected, the NW-striking features have the potential to sub-crop within the containment area, potentially affecting the DAPL zone.

The conclusions contain other errors and distortions. For example, it is stated that,

> "*OC-BB-1-2018 drilling and borehole geophysical logging indicates that the thickness of this lithology extends to the far side of the DAPL pool within the Containment Area and is therefore expected to underlie the DAPL pool. Based on drilling observation (primarily penetration rates), there may be zones in the lithology intercepted by OC-BB-1-2018 that are not as siliceous indicating the lithology mineral composition is changing gradually in stratigraphically higher sections (to the northwest); however, those zones with less quartz were also not fractured*

As noted in the analyses presented above, the lithologies penetrated by OC-BB-1-2018 do not extend to the far side of the DAPL pool within the containment area. There is simply no geologic basis for this statement. About stratigraphy, it is interesting that the text notes that, "*, there may be zones in the lithology intercepted by OC-BB-1-2018 that are not as siliceous indicating the lithology mineral composition is changing gradually in stratigraphically higher sections (to the northwest)".* Again, this conclusion is uniquely one-sided. What about the stratigraphically *lower sections* to the *southeast* (below the central part of the containment area)? These remain unassessed. The stratigraphy beneath the containment area is largely unknown and is likely more highly fractured due to the location within the core of a fold hinge as well as the presence of a NE-trending strike-parallel depression on the bedrock surface here, which also may correlate with a stratigraphic zone of higher fracture density.

As noted above, additional work is needed to assess the containment area. The data collected thus far suggests that there is a "sweet spot" beneath the central part of the containment area that is likely a large conduit for migration out of the containment area and further work targeted at this area would greatly enhance the CSM.

7. Geophysical and borehole Logs for OC-BB-1-2018; The borehole logs for OC-BB-1-2018 indicate numerous prominent features of interest. Likely fractures based on log responses (interpreted by the geophysical subcontractor) are highlighted in yellow on the logs and are summarized in the following table. It should be noted that each of the three major classes of fracture types discussed above are represented in each of the borings:

- Potential sheeting fractures are shown in rust colored font.
- NW-striking steeply-dipping joints are displayed in purple font.
- NE-striking fractures are shown in red font.

Comments above discuss these various fracture types and orientations in greater detail and the context of the investigation, efficacy of the containment area, etc.

Feature Number	Depth Ft btoc	Strike	Dip Direction	Dip angle	Aperture (mm)	Comment
NA	27-29					Weathered Bedrock (Drill log)
NA	32					Drill Log: Fracture; (Orientation unknown)
NA	35.5					Drill Log: Possible Fracture; (Orientation unknown)
2	43.2	218 (NE)	308 (NW)	26	< 1	Sheeting Fracture?
3	45.6	224 (NE)	314 (NW)	14	< 1	Sheeting Fracture?
4	46.0	243 (NE)	333 (NW)	15	< 1	Sheeting Fracture?
8	50.7	199 (NE)	289 (NW)	17	5	Sheeting Fracture? (note large aperture)
10	53.5	227 (NE)	317 (NW)	27	< 1	Sheeting Fracture?
12	55.9	210 (NE)	320 (NW)	30	< 1	Sheeting Fracture?
14	60.6	196 (NE)	286 (NW)	24	< 1	Sheeting Fracture?
16	67.1	84 (ENE)	174 (NW)	7	4	Sheeting Fracture? (note large aperture)
NA	67					Drill Log: Possible Fracture; (Orientation unknown)
18	68.1	N27E	287 (NW)	8	3	Sheeting Fracture? (note large aperture)
46	101	244 (NE)	334 (NW)	25	< 1	Sheeting Fracture?
48	104.9	N45E	315(NW)	72	2	Subparallel to Foliation
49	106.3	N36E	306(NW)	72	2	Subparallel to Foliation
57	114.7	N66W	204 (SW)	86	3	Sub-vertical; cross cuts foliation
60	116.6	N37E	307(NW)	72	4	Subparallel to Foliation
63	118.2	284 (NW)	14 (NE)	28	5	Sheeting Fracture? (note large aperture)
NA	147					"possible soft zone (Drill Log)
NA	153-171					"no observed fractures but some areas of soft/rapid drilling" (drill log) [stratigraphic-compositional change?]
102	176.0	N36E	306(NW)	66	10	Subparallel to Foliation

<u>Geophysical and borehole Logs for OC-BB-2-2018</u>; The borehole logs for OC-BB-2-2018 indicate numerous prominent features of interest. Likely fractures based on log responses (interpreted by the geophysical subcontractor) are highlighted in yellow on the logs and are summarized in the following table. It should be noted that each of the three major classes of fracture types discussed above are represented in each of the borings:

- Potential sheeting fractures are shown in rust colored font.
- NW-striking steeply-dipping joints are displayed in purple font.

- NE-striking fractures are shown in red font.

Comments above discuss these various fracture types and orientations in greater detail and the context of the investigation, efficacy of the containment area, etc.

Feature Number	**Depth Ft btoc**	**Strike**	**Dip Direction**	**Dip angle**	**Aperture (mm)**	**Comment**
5	32.3	225(NE)	315 (NW)	5	34	Sheeting fracture
NA	43					"possible fracture at 43 ft BGS based on air hammer (drill log)"
NA	58					"possible fracture based on air hammer (~ 58 ft BGS)"
59	95.6	223(NE)	313 (NW)	29	4	Sheeting Fracture? (note large aperture)
NA	115					"possible fracture (based on air hammer) ~ 115 ft"
102	138.6	292(NW)	22 (NE)	64	2	Steeply-dipping; cross cuts foliation
103	139.2	212 (NE)	302 (NW)	58	3	Subparallel to Foliation

APPENDIX 3

EPA Comments on Draft Remedial Investigation Report, Operable Unit 3, Appendix H, Numerical Modeling (March 30, 2018) Olin Chemical Superfund Site, Wilmington, Massachusetts

INTRODUCTION

A report entitled, Draft Remedial Investigation Report, Operable Unit 3, Olin Chemical Superfund Site, Wilmington, MA, March 30, 2018 (the "Draft OU3 RI Report" or "RI Report"), was prepared by Amec Foster Wheeler Environment and Infrastructure, Inc. on behalf of Olin Corporation, for EPA review. The following review focuses on *Appendix H, Numerical Modeling*, and certain sections of the RI Report that are associated with issues discussed in Appendix H. Appendix H contains a seven-page letter report entitled, *Conceptual Numeric Model of NDMA Fate and Transport in Fractured Bedrock, Olin Chemical Superfund Site, Wilmington, Massachusetts*, (and 25 associated figures) (the "Letter Report"). The Letter Report and modeling efforts were conducted by Dr. Neven Kresic (Woodard Curran) for Amec (now Wood) and Olin. The modeling effort is intended to support the concept of bedrock matrix diffusion and back-diffusion, and necessarily leans heavily on the rudimentary Conceptual Site Model ("CSM") provided in the RI Report. Given the limited documentation included in Appendix H, references to select sections in the RI Report are included where noted in the comments below to illustrate various technical points.

In addition to the RI Report, many meetings and discussions which are relevant to matrix diffusion and the modeling effort have taken place over the past 8 months or so. Dr. Kresic presented the model results at a technical meeting on February 7, 2018. In addition to feedback and discussion related to the prior modeling presentations, EPA has reviewed and commented on several related documents. The comments generated for these documents are germane to the modeling approaches contained in Appendix H, as well as the overall issue of producing a technically-defensible assessment of matrix diffusion/back diffusion for the site, especially for DAPL pools. The reader is therefore also referred to EPA's previously submitted comments on the following documents:

- *Containment Area Bedrock Boring Results, Olin Chemical Superfund Site (OCSS) in Wilmington MA (Site), May 10, 2018* (Memorandum prepared by Wood).

- *Rock Matrix Sampling Work Plan, Olin Chemical Superfund Site, Wilmington, MA* (rev. 1, May 1, 2018; prepared by Wood).

EPA has reviewed Appendix H and the documents above and, as documented in the comments below, concludes that the CSM and Conceptual Numerical Model are constrained by a general lack of data regarding the nature and extent of bedrock contamination. These data gaps must be addressed to develop a complete three-dimensional CSM for the Site and develop a valid Conceptual Numerical Model. These data gaps are separate and distinct from the overburden and shallow bedrock groundwater where previous data gaps have been closed and a clear understanding of the nature and extent of groundwater contamination exists. Collection of the data required in the following comments is not a prerequisite to the development of source control alternatives for all sources of contamination including the DAPL and contaminated groundwater that may act as an ongoing source to surface water and sediments and to the rest of the aquifer. A workplan for the collection of the data necessary to respond to these comments shall be developed and submitted to EPA for review and approval in accordance with the time frame established in EPA's cover letter for these comments.

GENERAL COMMENTS

1. The 2-dimensional model presented in Appendix H is a useful tool for analyzing and communicating various site scenarios. EPA particularly appreciates the concise and effective reporting of the model results and the illustrative figures. The model suffers, however, from a weak foundation; the underlying Conceptual Site Model (CSM) is missing many essential elements, and contains critical data gaps. As such, the resulting numerical model is poorly-constrained presently, and EPA is unable to concur with the conclusions drawn from the modeling now.

   Models, such as this one, can be useful in identifying critical data gaps, which can be addressed by iterative data collection efforts and concurrent model improvements. However, at this juncture, large data gaps in bedrock are obvious from a review of the RI Report. As a next step, additional analysis of basic data, including collection of data in specific areas of interest are needed to fully understand and model the full nature and extent of bedrock contamination. Such data gaps include the following:

   - Character and structure of bedrock beneath Main Street DAPL pool.
   - Determination/mapping of fracture networks in 3-D relative to Main Street DAPL pool.
   - Establishment and validation of appropriate bedrock monitoring locations and depths in near-field down-gradient areas immediately surrounding Main Street DAPL pool.

   In summary, EPA is unable to concur with the model's conclusions regarding the importance and severity of matrix diffusion and back-diffusion given the lack of key constraints in the areas of critical interest. However, EPA believes that the model, with improvements, could be a useful tool to evaluate various Site remedial alternatives for the bedrock groundwater once it is more carefully constructed in accordance with a more highly resolved CSM and input parameters which are better constrained by Site-specific data from the critical areas of interest. This model could then be used to supplement data gained through potential source control remedial efforts to develop a FS for the restoration of groundwater. The following comments discuss improvements EPA believes are necessary for the model to be useful as a decision-making tool moving forward.

2. <u>CSM - Main Street DAPL pool (general)</u>; It is interesting to note that the distal downgradient reaches of Maple Meadow Brook appear to be much better characterized than the DAPL source areas, particularly the Main Street DAPL pool, at least in in relation to bedrock. Numerous faults have been interpreted in this area from seismic reflection data, and at some oriented structural data from bedrock geophysical logs have been collected in that area. While still relatively poorly characterized, at least a rudimentary fracture network could be developed to inform the CSM for this distant area. et, little equivalent information exists concerning the character and structure of the bedrock beneath the Main Street DAPL pool area, which has been envisioned almost exclusively from depictions of the shape of the bedrock surface. The Letter Report discusses seismic data, shallow borings, and direct push explorations, all of which essentially provide *indirect* depth-to-bedrock information and have contributed to a *low-resolution*

elevation map of the top-of-bedrock surface in the Main Street DAPL pool area. It must be acknowledged that these types of bedrock surface elevation data are commonly subject to a lack of accuracy and precision and possible errors due to inherent limitations of the indirect methods. This was evident during the design of the DAPL extraction pilot in for the Jewel Drive DAPL pool where significant corrections to the bedrock surface elevations were necessary based on a series of borings. More importantly, the shape of the bedrock surface, while important, is not sufficient - in and of itself - to support an adequate characterization of the underlying bedrock. The glaring lack of bedrock characterization in this key source area makes it difficult to support the modeling effort associated with it. It is not appropriate to infer that conditions encountered in different portions of the immense Site study area are equivalent to those beneath the Main Street DAPL area. Additional data are needed, particularly oriented bedrock structural information, OTV/ATV logs and associated hydraulic testing, HPFM testing, from appropriately located bedrock boreholes, which will need to be carefully located and drilled using special protocols to minimize cross contamination from the overburden. Further requirements in this regard are discussed below.

3. It should be noted that EPA's analysis of the containment area DAPL pool suggests the presence of several classes of fractures, which are not presently known to exist beneath the Main Street DAPL zone (due to an absence of data). However, the oriented fracture data collected from across the Site suggests that their presence should be anticipated and investigated in all areas of the Site. These include the following:

   - Sub-horizontal to shallowly-dipping "sheeting" fractures.
   - Northeast-striking fractures - Moderate to Steeply dipping (to NW).
   - Northwest-striking fractures - Steeply dipping to sub-vertical.

   While these primary fracture orientations are not necessarily the only types of fractures, the presence of fractures of these orientations is almost certain beneath the Main Street DAPL pool. However, the location, spacing, hydraulic importance, apertures, hydraulic conductivity, and continuity and interconnectivity of the fracture network in this area is not yet known. EPA's alternative CSM for the Site makes preliminary interpretations in this regard based on work done for the containment area as well as the limited data existing for the Main Street DAPL pool.

4. <u>Main Street DAPL pool – Alternative CSM</u>; Even in the absence of critical information from bedrock beneath the Main Street DAPL pool, based on knowledge gained from detailed analysis recently completed for the bedrock region beneath the containment area DAPL pool, EPA has prepared a simplified alternative CSM for the Main Street DAPL pool (See Appendix 1 - Attachment 1 for a summary). We have reinterpreted/recontoured the bedrock elevation data presented on Figure 2.9-9 of the RI Report. This alternative rudimentary CSM is discussed briefly in the following paragraphs.

   Appendix 1 – Attachment 1 shows a reinterpreted top-of-bedrock elevation map based on data presented in the RI. This interpretation, while a non-unique representation of the data, honors many data points which were ignored or misinterpreted in Figure 2.2-9 presented in the RI. Key aspects of this alternative re-interpretation are as follows:

- Several NE-SW striking zones are interpreted which correspond to minor and major depressions mapped on the bedrock surface. These zones are interpreted to correspond with more highly fractured layer-parallel zones within the metamorphic sequence and/or faults, fractures or shear zones which have an orientation parallel or subparallel to foliation. The seven zones shown on the figure are labeled NE1 through NE7.

- At least 8 NW-SE striking fractures are interpreted which correspond to minor and major depressions on the bedrock surface of this orientation. These are interpreted to correspond to steeply dipping sub-vertical or steeply-dipping fractures of NW strike. The seven zones shown on the figure are labeled NW1 through NW8.

It should be noted that this interpretation is significantly different than the one presented in the RI Report in several critical areas. For example, the presence of significant zones of NW-striking fractures, which are parallel with the measured hydraulic gradients, would appear to provide the potential for significant contaminant migration pathways not currently accounted for in the CSM, numerical model, or for that matter the existing monitoring network. Recognition of this condition further highlights the need to develop source control remedial alternatives. The NE-striking fractures appear to cross connect with the NW-striking fractures, and as such, the fracture network appears to have some ability to convey contaminants, DAPL and dissolved-phase constituents, along strike and then to downgradient areas to the northwest into the Maple Meadow Brook area. This rudimentary model does not consider shallowly-dipping "sheeting" fractures, which are presumed to exist in the shallow subsurface and are included in the numerical model setup. These items are addressed further in comments below, particularly as they relate to the numerical model setup/CSM.

5. *Basis for Numeric Model Setup*: The site-specific basis for the numeric model setup needs further documentation and vetting. A revised model shall be constructed with the benefit of revised site-specific input data, as discussed in the following points.

    a. Sub-horizontal to shallowly-dipping "sheeting" fractures need to be more accurately represented in the model.
    b. Steeply dipping fractures of various orientations need to be more accurately represented in the model.
    c. Foliation-parallel fractures need to be more accurately represented in the model.
    d. A table needs to be created to determine the following information. It is anticipated that new boreholes will need to be drilled to determine actual values beneath the Main Street DAPL pool.

Fracture/Type Class	Strike	Dip	Average Spacing in MSDP area	Aperture Min Max Avg	Information Source/Ref (e.g., boring number, fracture numbers, depths, etc.)	Comment

    e. Similarly, the site-specific basis for the model's setup with respect to bedrock conductivities and porosity values needs to further vetted and documented. It is expected that additional site-specific hydraulic testing will be needed in appropriately located zones beneath the Main Street DAPL area to provide further technical basis for bulk and fracture specific hydraulic conductivities and porosity values.

f. A table needs to be created to compile and document the following information, once available so the model can be appropriately rebuilt and validated, as follows:

Fracture Type/Class	Porosity/basis	Hydraulic Conductivity Min/Max/geometric mean	Information Source/Ref (e.g., boring number, fracture numbers, depths, etc.)	Comment

6. <u>Model hydraulic gradient vis- -vis site-specific fracture orientations;</u> Olin shall clarify what specific hydraulic gradient was applied over the model domain from southeast to northwest. While the model addresses transport via shallow horizontal fractures, how could a 2-dimensional model be created with this same gradient magnitude and direction in the presence of significant vertical fractures with NW-strike (i.e., parallel to the modeled gradient of the head field)? How about northeast-southeast striking fractures? Both are significant contributors to Site flow, yet neither appear to be adequately simulated in this construction of the numeric model.

7. <u>NW-striking fracture pathways in bedrock</u>: It is likely that significant pathways exist in NW-striking fractures parallel to the measured hydraulic gradients. This geologically likely scenario needs to be fully vetted, and if validated, the model will require an extensive overhaul. In such a case, which appears far more plausible than the model setup criteria, significant relatively fast advective pathways in fractured rock may exist from the Main Street DAPL area to the distant discharge areas in Maple Meadow Brook to the northwest. It is even possible that such pathways may account for the *majority* of contaminant transport observed over these great distances over past decades, resulting in the formation of a broad diffuse plume in the Maple Meadow Brook wetland complex. While the existing CSM developed by Olin explains the conditions in Maple Meadow Brook as being the sole result of the gravity drainage of DAPL from relatively high bedrock elevations beneath the former lagoon areas to lower elevations in Maple Meadow Brook, advective transport through fractures is equally plausible and could present an ongoing source condition. See additional comments, above, and below.

8. <u>NE-striking fracture pathways in bedrock</u>: It is likely that significant pathways exist in NE- or SW-striking fractures oblique to the measured hydraulic gradients. The likely presence of such features would appear to promote advective flow in fractures out of the modeled domain more than represented here. This would in turn diminish the importance of matrix diffusion and matrix advection (normal to fracture orientation). How would the presence of such features affect the modeling? What changes are needed to make the model more realistic in this regard?

9. <u>Requirements</u>: A credible Technical Impracticability Evaluation (TIE) will need to consider additional data not yet available. While the current focus of the numeric model and the TIE is the Main Street DAPL pool, due to the geologic complexity of the area, EPA believes similar approaches and additional data are needed for the containment area DAPL pool, other DAPL pools and persistent source areas for which a TI zone is to be evaluated. At a minimum, the

containment area DAPL pool needs to be included in future TIE data collection efforts due to the more predictable geologic conditions there based on work to date. The following general requirements will improve the CSM for the Site to better inform the next iteration of numeric modeling:

- **Main Street DAPL pool**: Establish character and structure of bedrock beneath Main Street DAPL pool through direct interrogation with new boreholes using specialized drilling methods
    - Identification of specific fractures and determination/mapping of fracture networks in 3-D beneath the Main Street DAPL pool.
    - Determination of fracture characteristics
        - Orientation
        - Aperture
        - Continuity
        - Interconnectivity
    - Determination of hydraulic properties of bedrock
        - Hydraulic conductivity and porosity of bulk rock matrix
        - Hydraulic conductivity and porosity of distinct mappable fracture systems (secondary porosity)
    - Depth of penetration of COCs into unfractured rock matrix (rock coring) relative to mappable fracture systems

- Determination/mapping of fracture networks in 3-D downgradient to and connected to Main Street DAPL pool.
- Establishment and validation of appropriate bedrock monitoring locations and depths in near-field down-gradient areas immediately surrounding Main Street DAPL pool.

- **Containment Area DAPL pool**: Establish character and structure of bedrock beneath containment area DAPL pool through direct interrogation with new boreholes using specialized drilling methods;

    - Identification of specific fractures and determination/mapping of distinct fracture networks in 3-D beneath the containment area DAPL pool (same general data objectives and approaches as for Main Street DAPL pool)
    - Consider rock coring near sparsely fractured OC-BB-2-2018 to assess depth of penetration of COCs into unfractured rock matrix (rock coring) at known distances from mapped fractures, e.g., shallow sheeting fracture at base of casing.
    - Assess/validate potential for sub-horizontal sheeting fractures or previously unidentified steeply dipping fractures to allow/facilitate contaminant transport beneath and beyond the containment area in bedrock

- Determination/mapping of distinct fracture networks in 3-D downgradient to and connected to containment area DAPL pool.

- Establishment and validation of appropriate bedrock monitoring locations and depths in near-field down-gradient areas immediately surrounding containment area DAPL pool.

SPECIFIC COMMENTS

1. **Appendix H, Conceptual Numeric Model Report, page 1, 4th ¶;** The model report states "*The model focuses on interaction of NDMA with bedrock beneath the Main Street DAPL Pool, which is simulated using representative NDMA concentrations in groundwater and was constructed using representative Site data and conservative information from scientific literature.*" As stated above, EPA disputes the "representativeness" of the Site data used to construct the model as little to no Site bedrock data exists *beneath the Main Street DAPL Pool.*

2. **Appendix H, Conceptual Numeric Model Report, Model Hydrogeologic Framework and Geometry, page 2, 3rd ¶;** The model report states "*The model was constructed as a 2-dimensional cross-sectional model along the general groundwater flow direction from southeast to northwest, encompassing an approximated portion of the DAPL Pool source area shown in Figure 1*." Olin shall provide the cross-sectional alignment of the area of the model shown on an appropriate figure.

3. **Appendix H, Conceptual Numeric Model Report, Model Hydrogeologic Framework and Geometry, page 2, 4th ¶;** The text states **"***Three transmissive fractures, one horizontal and two vertical, are modeled in the competent bedrock directly below the DAPL Pool. The fractures are modeled conceptually with the smallest cell dimension of 0.6 inches corresponding to typical fracture apertures. The locations and dimensions of the fractures are approximated based on field logs and geophysical investigations. The actual spacing between the fractures (fracture frequency) is smaller than simulated in the model, and fracture orientation for different families of fractures varies at the Site from sub-vertical to sub-horizontal."*

   This part of the model construction requires additional documentation and vetting. It is not clear how 0.6 inches, other than a matter of convenience to the modeler, was selected as a representative fracture aperture. While fractures of this aperture size, and greater, are present at the site, most of the larger-aperture fractures seem to be located more proximal to the Bloody Bluff Fault zone (as described in the RI Report, see comments below). There are no fracture data near the Site except for GW-406-BRD. As stated previously, this well is hundreds of feet to the northeast, and may or may not be representative of the Main Street area subsurface. It is interesting to note that the logs for that borehole identified 71 features over approximately 140 feet of open borehole. This suggests a fracture frequency of approximately 1 fracture per each 2 vertical feet of borehole. However, many of these had negligible aperture (listed as "0"). Even so the arithmetic mean of the 71 fractures was ~ 0.21 inches. The borehole intersected 17 features (frequency = 1 fracture per 8.2 vertical feet of borehole) of measurable aperture (range = 10-92 mm) with an arithmetic mean of 0.87 inches. The largest fracture was noted at 92 mm or approximately 3.2 inches. Even without dissecting the data further based on orientation, it seems like the actual fracture spacing is much smaller and apertures are much larger than the model accounts for. The model does not seem to represent the fracture network realistically. See general comments above.

4. **Appendix H, Conceptual Numeric Model Report, Model Hydrogeologic Framework and Geometry, page 3, 1st ¶;** The text goes on to state *"In addition, the modeled horizontal fracture does not extend beyond the footprint of the DAPL Pool. Although this may under-predict the NDMA extent, the objective of the model was to conceptually demonstrate F&T of NDMA as it flows through various porous and fractured media."* In addition to the *horizontal extent* of the shallow fracture put into the model, the frequency and aperture need further documentation and vetting. EPA's analysis of the limited borehole data suggests a much larger number of shallow horizontal fractures in the upper portion of the bedrock. For example, our assessments of OC-BB-1-2018 and OC-BB-2-2018 suggest the presence of multiple shallow sub-horizontal fractures to a depth of 100 feet, approximately 70 feet into bedrock. There are 13 such features in OC-BB-1-2018, generally of smaller aperture. OC-BB-2-2018 detected fewer sub-horizontal fractures, but a significant fracture may exist at the base of the casing here with an aperture of 32 mm or 1.25 inches. Again, the model does not seem to represent the fracture network realistically in relation to shallow sheeting fractures (sub-horizontal). See general comments above.

5. **Appendix H, Conceptual Numeric Model Report, Input Parameters, Page 2, 1st ¶;** The report states *"Hydraulic conductivity and effective porosity values assigned to four functional model units are based on site-specific geology, field data including available slug tests (MACTEC, 2007), and literature sources."* However, no specific sources are provided for any of the data. As more refined input parameter tables are created (see general comments, above), specific references for each input data parameter will be needed for vetting and possible modification, with a bias toward site-specific data beneath and proximal to the Main Street DAPL pool.

6. **Appendix H, Conceptual Numeric Model Report, Input Parameters, Page 2, 2nd ¶;** The report states "*Due to the metamorphic nature of the bedrock sediments including intensive deformations in all spatial directions, the horizontal and vertical hydraulic conductivity assigned to bedrock units are the same: 10-6 cm/s (0.002835 ft/d) for the weathered bedrock and 10-7 cm/s (0.000284 ft/d) for the competent bedrock."* This conceptualization does not square with reality on several levels. What is the source/basis for the conductivity values provided for weathered bedrock and competent rock? It is presumed that these values pertain to "bulk" or matrix, rather than fractured zones? Olin shall clarify. What actual data exist for "weathered bedrock" at the Site? How is weathered bedrock defined? The actual values may be much higher than "unweathered" bedrock. Olin shall clarify this information, and in so doing, Olin shall provide concise and internally consistent definitions for "weathered rock" and "unweathered rock." Why is 10 feet the appropriate thickness for the weathered layer? What data informs this?

7. **Appendix H, Conceptual Numeric Model Report, Input Parameters, Page 2, 2nd ¶;** The report further states: *"Effective porosity of 2% (0.02) and 0.5% (0.005) was assigned to weathered rock and fractured rock respectively. As part of model evaluation, hydraulic conductivity and effective porosity values for the competent bedrock were also changed to 10-6 cm/s and 1% (0.01) respectively to evaluate their sensitivity with respect to calculated NDMA concentrations."* The porosity and conductivity values for *weathered rock* may be much higher than what is assumed here. Consideration shall be given to running sensitivity analyses over a broader range, and to include weathered bedrock in the scenarios.

8. **Appendix H, Conceptual Numeric Model Report, Input Parameters, Page 3, 3rd ¶;** The report states: "*Hydraulic conductivity of the fractures was estimated at 0.5 ft/d and was also modeled with 5 ft/d to evaluate the effects of increased groundwater flux through fractures. The effective porosity of fractures was estimated at 80% to account for any irregularities including asperities.*" These hydraulic conductivity values stretch credibility. While they may be reasonable for "tight" fractures with small apertures, the low conductivities are not consistent with the huge apertures (0.6 inches) assumed for the fractures in the model. Site-specific conductivity data is needed in the areas of interest to better constrain both bulk/matrix and fracture zone hydraulic conductivities. See general comments, above.

9. **Appendix H, Conceptual Numeric Model Report, Input Parameters, Page 3, 4th ¶;** The report states: "*Considering that the model domain resides within an area where paved and other low-permeable surfaces are predominant, recharge was assumed to be low and estimated as 9.6x10-4 ft/d or 10 percent of the total reported annual average precipitation of 42 inches. This estimate was supported by resulting hydraulic heads within the model domain. Recharge of higher values resulted in notable mounding of groundwater within the model domain.*" The recharge values appear to be on the low side. Typical model values are more on the order of 50 percent of annual recharge. The observations regarding mounding in the model domain under higher recharge scenarios is perhaps simply a manifestation of the very low conductivities the model used for all parameters, particularly the bedrock fractures. Recharge shall be revisited once more realistic Site-specific hydraulic conductivity values are available.

10. **Appendix H, Conceptual Numeric Model Report, Fate and Transport Parameters, Page 4, 3rd ¶;** The report states: "*Diffusive transport is typically only significant when groundwater velocity is very low, as it becomes a primary method of contaminant migration*." As noted in the receding comments, it seems possible that the model contains a systematic bias which minimizes advective flow to unrealistically low levels, which in turn promote diffusive transport at higher levels than would otherwise be expected. This issue shall be revisited once more realistic Site-specific values are available for hydraulic conductivity and other parameters.

11. **Appendix H, Conceptual Numeric Model Report, Model Results, Page 5, 2nd ¶;** The report states: "*Figures 5 and 6 show the predicted NDMA concentrations 50 years after formation of the DAPL pool for the same basic set of input parameters and assumptions. The advective transport component results in more widely spread NDMA presence in both the overburden and the bedrock while the impact of matrix diffusion in the bedrock is generally less than 5 additional feet except directly below the DAPL Pool where it is between 5 and 10 feet.*" These predictions shall be used to create testable hypotheses regarding the observed length scales to which NDMA has invaded the bedrock matrix after roughly 50 years. The rock coring program envisioned by Olin could help elucidate this data gap, but the strength of any such assessments will rest on the quality and robustness of the understanding of the Site-specific fracture networks beneath and surrounding the Main Street DAPL pool. The goal is to interrogate unfractured matrix at a variety of definable distances away from known fractures to validate and or modify/refine the model's assessment of matrix diffusion. See general comments, above.

12. **Appendix H, Conceptual Numeric Model Report, Model Results, Page 5, 3rd ¶;** The report states: "*Key components of NDMA migration through the Site's porous media are shown schematically in Figure 7. The advective transport is dominant and its rate depends directly on*

the hydraulic conductivity: the highest rate is in the overburden sediments, followed by the weathered rock and then the competent bedrock matrix. Direct transport through fractures is limited by their extent while, at the same time, they act as continuing sources of high NDMA concentrations in excess of 1,000 ug/L in the adjacent bedrock matrix." Figure 7 appears to suggest on the order of 20 feet of *advective* transport into the bedrock matrix to the northwest of the vertical fracture into unfractured matrix. Is this realistic? It is puzzling how overburden sediments are depicted with the highest advective transport rates, followed by "weathered bedrock" and "competent bedrock matrix." What about bedrock fractures? One would intuitively expect the large aperture fractures assumed for the Site to have commensurately large lateral extents and high hydraulic conductivities. One would expect such fractures to exhibit the highest rates of advective transport, by far. The text notes that the "transport through fractures is limited by their extent while, at the same time, they act as continuing sources of high NDMA concentrations." Again, this paints an unrealistic picture of Site conditions. Rather, it is more likely that significant pathways exist in NW-striking fractures parallel to the measured hydraulic gradients. This geologically-likely scenario shall be fully vetted, and if validated, the model will require an extensive overhaul. See general comments, above.

13. **OU3 RI, Page ES-3, 2nd ¶;** The report states, "*Modeling corroborates the technical understanding that bedrock fractures act as secondary sources of groundwater dissolved NDMA contamination for the surrounding rock matrix primarily due to advective transport, but also due to matrix diffusion. The model also predicts that restoration of bedrock groundwater will take a very long time, over several hundred years, and is an unrealistic expectation and likely to be technically infeasible*." EPA does not concur with these conclusions as there is insufficient technical basis to support them presently.

14. **OU3 RI, Page ES-3, 4th ¶**; The report states, "*The RI report also recommends a Technical Impracticability Evaluation (TIE) be formally initiated to evaluate technical barriers for restoration of bedrock groundwater in a reasonable time frame within the Ipswich watershed. The TIE should also consider the relationship between the bedrock and overburden aquifers within the same context. This evaluation should be developed concurrently with the review feasibility studies so findings can be considered and incorporated into a final approved remedy for the Site*." While EPA agrees that TI could be evaluated for bedrock, the current database does not allow for an adequately robust TIE. While the TIE may consider the relationship between the bedrock and the overburden aquifers, the amount of gross contamination currently present within the overburden aquifer is well characterized, and exceeds risk-based and regulatory thresholds. Requirements for next steps in this regard are included in the Requirements, above.

15. **OU3 RI, Section 3.2.3 – Bedrock Geology and Structure, page 3-5, 4th ¶**; The report states "*Several studies have been conducted to characterize the underlying bedrock topography and to understand how the shape of the bedrock surface relates to both groundwater flow and the past migration of site-related contaminants. These studies, including the Supplemental Phase II investigation (Smith, 1997), which included completion of numerous borings and seismic reflection, and refraction surveys, additional seismic investigations of the MMB area, the Main Street Bedrock Saddle Investigations, and the off-PWD Seismic Investigation are described in Section 2.1.2.9. More recent iU3 seismic investigations included seismic studies in the WBV under Main Street and the MTBA Rail line (Seismic Refraction Survey Data Report, MACTEC, March 10,*

2011) to support installation of the GW-400 and GW-404 well clusters, and along the western property line of the Site north of the Containment Area (Seismic Refraction Survey of Line 3 at the Olin Chemical Superfund Site, NGS, June 2011) to confirm no additional bedrock depressions were located west of former Lake Poly." While EPA agrees that the shape of the bedrock surface represents an important indicator of groundwater flow and contaminant migration pathways, EPA's evaluation of the previously completed geophysical surveys in the Main Street DAPL pool area has produced a significantly different interpretation. Please see general comments above.

16. **OU3 RI, 2.1.2.9. Seismic Investigations, Page 2-12, 2nd ¶** The RI Report notes "*RAYPATH seismic reflection line SE-95-16 in the vicinity of GW-83D where DAPL is present shows the presence of several pronounced vertical faults that continue out along the WBV and become more frequent under the confluence of MMB and Sawmill Brook (Seismic line BCM-94-3). It is unlikely that the presence of these geologic structures allowed a stable pool of DAPL to persist within this portion of the WBV. Similar fault structures were not interpreted to exist near the Main Street DAPL pool where similar seismic investigations were conducted.*" While this conclusion may be mostly true, it must be noted that of the 3 seismic reflection lines described here (shown on Figure 2.2-9), two are exceedingly short in length (<250 ft.), and thus have diminished capability to discern features such as the types of near-vertical faults identified near GW-83D. The third line, while on the order of 450 feet in length, is oriented *generally parallel to regional strike* and as such offers diminished capability to detect the types of steeply dipping strike-parallel features one would expect in this area. It is further noted that the large northeast-striking depression on the top-of-bedrock surface in the central part of the Main Street DAPL pool, despite its width of over one hundred feet and strike length of 750+ feet, was essentially missed by the seismic surveys excepts for the peripheral areas surveyed along the margins. As such, there is a high likelihood that this large strike-parallel zone contains layer-parallel and/or strike-parallel shear faults of steep to moderate angles coincident with the regional strike. In the general comments, above, EPA has provided an "alternative CSM" which reinterprets the seismic data from the Main Street DAPL pool in a manner consonant with the Site-wide bedrock structure and fabric.

17. **OU3 RI, 3.2.3.1. Regional Faults and Structure;** The text describes the Bloody Bluff fault, west of the site, as follows: *"The dominant bedrock structure is the Bloody Bluff Fault and the associated zone of shearing in bedrock known as the Burlington mylonite zone, which extends up to several miles east of the Bloody Bluff Fault. The Bloody Bluff Fault trends northeasterly within uplands along the western margin of the MMB wetland and crosses the wetland north of Main Street. The fault dips northwesterly at angles varying from 45 to 75 degrees based on published aeromagnetic and gravity surveys (in Castle et.al., United States Geological Survey [USGS] Bulletin 1410). The Bloody Bluff Fault represents a zone of brittle deformation and is believed to represent an area of significant dislocation between the Nashoba Zone to the north and west and the Avalon Zone to the south and east. The Burlington Mylonite zone is interpreted to be part of the zone boundary that is contained within the Avalon portion of the terrane.*

As discussed in the next section, borehole geophysical logging of bedrock show more extensive and complex brittle fracturing of bedrock between the WBV and the Bloody Bluff fault and along the axis of the WBV. For this reason, GW-407BR, GW-65BRD, GW-400BR and GW-404BR all appear to be extensively fractured and the individual fractures and zones of fracturing have comparatively enlarged apertures. On the southern and eastern side of the WBV within the Burlington Mylonite Zone, farther removed from the Bloody Bluff Fault, the bedrock appears more competent and less fractured, though the degree of fracturing can still be quite frequent *depending on rock type. Within zones of bedrock with high silica content the style of deformation would have been more ductile and less brittle owing to a high degree of recrystallization of microcrystalline - quartz during metamorphism and folding. Thus, boreholes that intersect quartzite (GW-202BR and the bottom of GW-405BR) appear highly competent and at most, only weakly fractured. In contrast the fine grained and finely layered schist and gneisses of the Avalon Zone (GW-406 for Example) are moderately to well fractured."*

This generalized assessment is geologically reasonable, but insufficient to properly inform the CSM and numeric model at the scale of the Main Street DAPL pool. In simple terms, the observations could be restated simply to indicate that fracture density decreases with distance away from the Blood Bluff fault zone. That said, it is difficult to determine how this information could be used to predict bedrock conditions beneath the Main Street DAPL pool which could inform the CSM and numeric model such as fracture orientation, dip, style, density, aperture, continuity, etc. GW-406BRD appears to be the only borehole with comprehensive borehole logging data near the Main Street DAPL pool. et, it is located on the order of 400 feet to the northeast in what is mapped as the Aberjona river basin, and approximately 200 feet to the SE, stratigraphically down-section, i.e., to the SE. As such, the rock units penetrated by this borehole are not likely to correlate with the rock units beneath the Main Street DAPL pool. Olin shall clarify how GW-406BRD was or was not used to inform the "Setup" for the Numeric Model in Appendix H. Additional data is needed to properly constrain conditions beneath the Main Street DAPL pool for the CSM and numeric model.

18. **OU3 RI, 3.4 Bedrock Groundwater System;** The text states, "*Based on extensive bedrock coring and mineralogical assessments (Smith, 1997), and borehole geophysical investigations (Smith, 1997, and Geomega, 2001c and Geomega, 2001d) the bulk movement of bedrock groundwater is dominated by secondary porosity features, such as fractures and in some areas faults. Locally, orientation of fractures is dominated by past tectonic deformation and the presence of structures such as the Bloody Bluff Fault Zone giving rise to a dominance of the northeast-southwest fractures within the bedrock fabric. Groundwater hydraulic conductivities measured in the bedrock in GW-62BR ranged from 0.04 to 0.06 ft./day. These values are representative of typical conditions found elsewhere in New England metamorphic sedimentary rock. Spatial distribution of bedrock groundwater flow parallels overburden and is also divided between two water sheds as discussed earlier. Bedrock borehole GW-202BR installed adjacent to the Containment Area indicated very competent rock consistent with the boring log from BR-1 drilled in the on-Property DAPL pool. Boreholes GW-405BR and GW-406BR at opposite ends of Jewel Drive had slightly more fracturing, but were consistent with and typical of bedrock boreholes drilled in similar metamorphosed rock in New England, where fractures are typically related to bedding and axial plane fracturing/jointing. The top five to ten ft. of bedrock in these wells typically exhibit the presence of a slightly weathered zone that is generally expected to have slightly higher transmissivities than the underlying competent bedrock. Bedrock geology with structural features are included as Figure 3.4-1.*"

This information is not adequate to inform a robust CSM and numeric model for the Site. Figure 3.4.1 simply shows the bloody bluff fault (mislabeled as the "Massachusetts fault") and rose diagrams from each boring. No effort is made to interpret structures identified at disparate locations into a cohesive structural model (i.e., "connecting the dots"). Moreover, many of the general statements here are not well supported or are counter to the actual site-specific data. For example, the statement which reports hydraulic conductivity values from GW-62BR as 0.04

to 0.06 ft./day, and then states that these values are “representative” of “typical conditions found elsewhere in New England metamorphic sedimentary rock,” is not well supported. Are the reported hydraulic conductivity values “bulk” values or from specific fracture zones? Are modern borehole geophysical logs available for GW-62BR? Olin shall clarify how these assertions have informed the setup for the numeric model.

19. **OU3 RI, 5.2.2 Site Groundwater Within the Ipswich River Watershed;** The report notes:

“Bedrock groundwater underlying the Main Street DAPL pool within the Ipswich watershed is impacted by NDMA. The known depth of impact is over 100 ft. into bedrock and based on hydrogeology and conservative fate and transport assumptions. In a like manner bedrock underlying the WBV within the MMB aquifer is also believed to be impacted. This would include the area from MP-4, through GW-62BR/BRD, GW-83D, MP-5, GW-84D, GW-85D to GW-87D (Figure 4.4.1-1).

Numerical modeling has been conducted to better understand the implications on contaminant fate and transport from long term exposure of fractured bedrock to high concentrations of NDMA as these conditions have important implications for developing realistic remedial expectations and decisions. Results of numerical modeling are included in Appendix K (note, it is actually located in Appendix H). The simulations conceptually looked at fractured bedrock underlying the Main Street DAPL pool. The purpose was to quantify the probable extent of impacts in bedrock aquifer matrix around fractures and the weakly fractured matrix between major identifiable fractures. Modeling allowed transport to occur over the time interval the DAPL pools are believed to have first formed to current day (50-year loading period). Numerically DAPL was removed from the model and the model was run forward for 300 years to see how those modeled distributions would change with time. Modeling was conducted considering diffusion and advection/dispersion, together and independently. The modeling effort indicates the mass of NDMA remaining in bedrock after 300 years would present a significant barrier to achieving groundwater restoration such that groundwater could be used as a water supply resource without treatment. Removal of DAPL does not appreciably change the nature of contamination in fractures and matrix over that long-time period. Thus, removal of DAPL as remediation strategy will not contribute significantly to groundwater restoration for fractured bedrock. Olin is in the planning process of installing borings (note to date Olin has proposed a single boring) for collection of rock matrix samples to validate this component of the conceptual model. Since the same matrix diffusion effects apply to bedrock located under the MMB aquifer, restoration of that aquifer is also improbable or impracticable due to the long-time frame back diffusion would occur from affected rock matrix. If the MMB aquifer is to be used in the future for water supply, the combined overburden and bedrock aquifer could not be restored in a reasonable time frame such that treatment of the water would not be needed. This is because pumping from the overburden aquifer will result in vertical movement of contaminated bedrock groundwater into overburden. The productive use of the overburden aquifer for water supply, which is feasible and reasonable, would simply require additional treatment to remove NDMA and any additional contaminants as identified by the BHHRA.

While the phenomenon of matrix diffusion is well known, the importance in each site/setting must be evaluated on a site-specific basis. The statements offered here regarding the restoration potential of the aquifer are essentially professional opinions informed by a numeric model which was built on a weak CSM, an incomplete data-set and un-founded assumptions. It is appropriate and necessary to validate this "component" of the CSM. Specialized rock coring techniques and analyses may be a useful piece of the validation effort, but EPA's review has noted additional components of the CSM which will need further effort. Until such steps are taken and approved by EPA, EPA rejects the conclusions offered here and elsewhere regarding the intractability of the matrix bound fraction of contamination at the Site, and how this will or will not affect remedial scenarios. Regardless, it is EPA's position that the mass of contamination in the overburden and shallow bedrock is well characterized. Please see general comments, above.

20. **OU3 RI, 5.2.3 Migration Route Summary:** The report states: "*In summary, the major potential routes of migration for contaminants in OU3 groundwater include:*
Ipswich Watershed
    - *Continued vertical transfer of soluble DAPL constituents by diffusion to a limited thickness of groundwater immediately overlying the DAPL pools (Diffuse Layer) and diffusive loss of constituents to underlying fractured bedrock groundwater.*
    - *Downward and lateral migration of dissolved groundwater contaminants in fractured bedrock under and then downgradient beneath the MMB aquifer, eventually discharging upward into deep overburden groundwater.*
    - *Migration and transfer of NDMA and other dissolved solutes from open fractures into adjacent rock matrix and movement of this solute mass into bedrock matrix by diffusion and matrix advection.*
    - *Movement of groundwater from the GW-413 Area northeast of the Property along a yet to be determined flow path.*

    It is noteworthy and somewhat puzzling how this assessment of migration discusses "matrix advection" in bedrock, yet the primary migration pathway, i.e., *advective flow in bedrock fractures*, is not specifically mentioned. It is not clear that the model appropriately simulates transport in bedrock for either DAPL or dissolved phase constituents. Huge fracture apertures have been selected to facilitate/exaggerate diffusive transport of DAPL constituents into bedrock, yet the same huge apertures have been assigned miniscule hydraulic conductivity values, which further exaggerate diffusive aspects of mass transfer and minimize advective transport. This approach seems unrealistic as well as internally inconsistent. The model shall be reconstructed with realistic Site-specific values for all key parameters. See General Comments, above.

21. **OU3 RI, 5.4 Contaminant Fate and Transport Summary**; The RI notes: "*The DAPL material, which moved primarily in response to gravity, migrated to the west and northwest within a sloping bedrock valley (the Western Bedrock Valley and remains in isolated DAPL pools in bedrock depressions located both on- and off-Property. The migration of this dense fluid was accompanied by convective mixing with groundwater resulting in an area of dissolved DAPL constituents in the deeper portions of the overburden aquifer, including on-Property areas. The primary current mechanism for release of these dissolved constituents from the DAPL pools is chemical diffusion, which is a slow and inefficient mass transfer process. DAPL is an on-going source of contaminants to the Diffuse Layer.*"

    EPA questions this assessment. Olin shall provide further details concerning the "convective mixing" fate and transport scenario mentioned here, and how this informed by Site data. As presented in the general comments, above, EPA's analysis suggests that fracture pathways are likely in bedrock which may connect the Main Street DAPL pool with the WBV areas to the northwest. Such pathways could facilitate density driven DAPL migration to the northwest as well as advective transport of dissolved phase constituents. There appears to be much indirect data to support such NW-striking fracture pathways. There is an absence of bedrock data in the area beneath the Main Street DAPL pool itself as well as the areas immediately downgradient to the northwest. The closest downgradient well in bedrock (GW-62BRD) is on the order of 600 feet downgradient (e.g., the combined length of two football fields). It will be necessary to install wells in the near-field downgradient areas to the northwest of the Main Street DAPL pool to clarify fate and transport processes so the CSM and numeric model can be properly informed. This process will need to involve identifying and targeting NW-striking fractures, likely to be steeply-dipping to near vertical with appropriate geophysical, drilling, and testing techniques. Please see general comments, above.

22. **OU3 RI**, **7.2 Recommendations:** The recommendations listed in the RI Report include the following: "*The OU3 FS should develop RAOs and consider alternatives that address:*

- *Potential potable use of groundwater from the MMB aquifer*
- *Continued DAPL extraction at the off-PWD DAPL pool as an upgradient source for OU1 OU2 surface water*
- *DAPL at the Main Street and on-Property DAPL pools*

Finally, consideration should be given to initiating a formal Technical Impracticability Evaluation for NDMA in fractured bedrock underlying the Main Street DAPL pool and the WBV."

While EPA generally endorses these somewhat generic recommendations, the FS focused on source control alternatives for OU1, OU2 and OU3 shall include RAOs geared toward the removal of OU3 source material, which includes DAPL and contaminated groundwater that may act as an ongoing source to surface water and sediments and to the rest of the aquifer, from the overburden and shallow bedrock fractures, in conjunction with groundwater containment strategies. The data derived from these efforts will inform an updated CSM and numeric model. Specific recommendations relative to the TIE are offered above, in the Requirements section.

APPENDIX 4

EPA Comments on Revised Rock Matrix Sampling Work Plan (July 6, 2018) and related information provided by Olin/Wood in a letter dated June 26, 2018
Olin Chemical Superfund Site, Wilmington, Massachusetts

INTRODUCTION

A document entitled, *Revised Rock Matrix Sampling Work Plan, Olin Chemical Superfund Site (OCSS), Wilmington, MA,* was transmitted to EPA via cover letter on July 6, 2018. The transmittal also included *Response to Comments dated May 22*, which are reflected in the revised draft workplan. This material was preceded by another letter from Olin dated June 26, 2018, entitled, *Schematics, Bedrock Matrix Sampling Workplan, Olin Chemical Superfund Site (OCSS), Wilmington, MA*. The June 26 letter contained several figures which were subsequently included in the *Revised Rock Matrix Sampling Work Plan*.

Despite the comment and response exchange, Olin and its technical subcontractors have an incomplete understanding of the requirements needed to perform a technically-defensible Technical Impracticability Evaluation ("TIE"). Olin's TIE proposals suffer, together with the Draft OU3 RI Report and related documents, from a weak Conceptual Site Model ("CSM") for bedrock. While considerable data has been collected from overburden zones, as well as a moderate degree of information concerning the bedrock/overburden interface and shallow bedrock, the Site is essentially devoid of characterization in the mid-depth to deeper levels of bedrock, except for a handful of deep bedrock boreholes scattered over the huge Site area, which is on the order of two square miles.

This shortfall of bedrock characterization is therefore a common theme that has been identified for many of the RI/FS submittals EPA has reviewed over past months. Relevant technical issues, which are germane to the TIE generally, as well as the specific proposals presented in the *Revised Rock Matrix Sampling Work Plan* are discussed in EPA's comments on the following documents:

- *Containment Area Bedrock Boring Results, Olin Chemical Superfund Site (OCSS) in Wilmington MA (Site), May 10, 2018* (Memorandum prepared by Wood).

- *Rock Matrix Sampling Work Plan, Olin Chemical Superfund Site, Wilmington, MA* (rev. 1, May 1, 2018; prepared by Wood).

- *Draft Remedial Investigation Report, Operable Unit 3, Olin Chemical Superfund Site, Wilmington, MA, March 30, 2018,* prepared by Amec Foster Wheeler Environment and Infrastructure, Inc. on behalf of Olin Corporation.

- *Appendix H of Draft Remedial Investigation Report, Operable Unit 3, Olin Chemical Superfund Site, Wilmington, MA, March 30, 2018, (Numerical Modeling).* [Appendix H contains a seven-page letter report entitled, *Conceptual Numeric Model of NDMA Fate and Transport in Fractured Bedrock, Olin Chemical Superfund Site, Wilmington, Massachusetts*, (and 25 associated figures).]

In addition to the comments on the *Revised Rock Matrix Sampling Work Plan,* below, the comment packages EPA prepared for these documents include further clarification regarding technical issues pertaining to the shortfall of bedrock characterization.

GENERAL COMMENTS

1. EPA has reviewed and has developed extensive comments on several OU3-related RI/FS documents over recent months. Many of the comments generated for these documents address CSM issues which are germane to the proposed rock matrix sampling approaches, the modeling approaches contained in Appendix H of the Draft OU3 RI Report, as well as the overarching issue of producing a technically-defensible assessment of matrix diffusion/back diffusion for the Site, especially for DAPL pools. For example, the following comment prepared for Appendix H of the Draft OU3 RI Report is repeated here, as follows:

   EPA has reviewed Appendix H and the documents above and, as documented in the comments below, concludes that the CSM and Conceptual Numerical Model are constrained by a general lack of data regarding the nature and extent of bedrock contamination. These data gaps must be addressed to develop a complete three-dimensional CSM for the Site and develop a valid Conceptual Numerical Model. These data gaps are separate and distinct from the overburden and shallow bedrock groundwater where previous data gaps have been closed and a clear understanding of the nature and extent of groundwater contamination exists. Collection of the data required in the following comments is not a prerequisite to the development of source control alternatives for all sources of contamination including the DAPL and contaminated groundwater that may act as an ongoing source to surface water and sediments and to the rest of the aquifer.

   The following comments address general and specific issues related to the CSM that will need to be addressed before the Revised Rock Matrix Sampling Work Plan can be properly evaluated.

2. <u>Adequacy of CSM for bedrock (general)</u>; The current CSM for bedrock is inadequate to support a TIE. By extension, the information is also insufficient to produce a credible numeric model, as the numeric model is informed by Site data. Olin/Wood have referenced other sites such as the Quarry site at the former Loring AFB in Limestone, Maine as well as the Eastern Woolen Mill Superfund site in Corina, Maine as "analogues" to the Site, but these comparisons are puzzling given the significant disparity of bedrock characterization at the Site in comparison to these other sites. A brief synopsis of these sites serves to illustrate the vast differences and inadequacy of the Site characterization relative to bedrock as things now stand.

   The Loring AFB quarry site source area was on the order of a half-acre in size, yet the characterization done for the RI/TIE was informed by:

   - Significant source control actions including removal of over 500 drums and associated soils down to bedrock surface,
   - Many deep boreholes with full-suite modern borehole geophysical logging,
   - Extensive vertically-discretized packer sampling and specific conductivity testing at all bedrock depth intervals,
   - The site's location within a former rock quarry presented abundant rock exposures, which enabled preparation of detailed geologic/fracture mapping in 3-D,
   - Surface geophysical surveys,

- Detailed oriented geologic/fracture data in the areas of critical interest, and
- A detailed 3-dimensional hydrogeologic model.
- Etc.

Similarly, at the Eastern Woolen Mill Superfund site in Corina, Maine, another relatively small site in comparison, the TIE was informed by:

- Source control actions including:
  - Demolition and removal of contaminated mill buildings
  - Excavation/treatment/replacement of 75,000 cu. yds. of contaminated soil
  - Limited pump and treat
  - ISCO of source zones
- Many deep boreholes with full-suite modern borehole geophysical logging over entire site
- Many deep boreholes focused to 2-3-acre source area
- Extensive Rock Core including within source area
- Extensive vertically-discretized packer sampling and specific conductivity testing at all depth intervals
- Surface geophysical surveys including a pilot test of state-of-the-art 3-D ERT methodology
- State-of-the-art FLUTe borehole liners and multi-level sampling systems
- Detailed oriented geologic/fracture data in the areas of critical interest
- A 3-dimensional hydrogeologic model
- Etc.

Considering these cursory comparisons, EPA questions Olin/Woods' assertions of similarity. The Olin Site, in general, over its 2+ square miles, has fewer bedrock boreholes than the comparatively tiny source areas of these "analogue" sites. Moreover, the actual DAPL areas at the Site are essentially uncharacterized with respect to bedrock other than a minimal level of characterization on the bedrock-overburden contact. Clearly, additional efforts are needed with respect to bedrock.

3. *Adequacy of CSM for bedrock (scale issues)*; As stated above, at the scale of the source area/DAPL pools, there is little information that can adequately inform a CSM, numeric modeling, or matrix diffusion assessments. As such, a TIE is premature.

   For, example, except for the recently drilled borehole OC-BB-2018-2 within the containment area, there are no cores or deep open borehole bedrock explorations within any of the DAPL source areas which can inform in-situ fracture occurrence, frequency, orientation, and other critically important data needs. The Main Street DAPL pool is clearly deficient in this regard, and as such, Olin/Wood's CSM for the Main Street DAPL area (and other DAPL areas) is inadequate. To amplify this problem, lack of hard constraints easily allows for alternative interpretations which differ significantly from the stated CSM. To illustrate this point, EPA performed additional analysis on existing data for the Main Street DAPL pool presented in the Draft OU3 RI Report ("RI Report"). A comment (*Main Street DAPL pool – Alternative CSM*) offered on Appendix H of the RI Report presents this analysis in greater detail. To produce this analysis, EPA simply reinterpreted/recontoured the bedrock elevation data from borings and seismic data presented on Figure 2.9-9 of the RI Report. The result is included in Appendix 1 - Attachment 1, which shows profound differences from the interpretation depicted on Figure 2.9-9 in the RI Report. The revised interpretation has significant implications, and while this is not a unique interpretation of the data set, our top-of-bedrock contour map forms the basis for an improved CSM as it more closely honors *all the data* presented. Significant differences include the following:

a) There appears to be a pronounced northwest striking valley feature that connects the subsurface beneath the Main Street DAPL area with the MMB area and downgradient areas. The feature has many hundreds of feet of strike length and likely correlates with a relatively tightly spaced zone of NW-striking steeply-dipping fractures. As such, both this “trough” on the top of the bedrock surface as well as the underlying fractures in the bedrock provide pathways by which DAPL and dissolved contaminants may migrate from the Main Street DAPL area into the MMB valley via density-driven and hydraulic gradients.

b) Additional NW-striking grooves have been interpreted on the bedrock surface and likely also correlate with underlying fractures in bedrock of this orientation. The so-called Main Street DAPL area “saddle” appears to be a feature of this class, although it is not as large or as significant as the “new” feature discussed in a), above.

c) A large NE-SW striking depression on the bedrock surface is shown in the central portion of the Main Street DAPL area. This feature is on the order of 700 feet in strike length and 100 feet in width. It is likely that this zone is related to layer-parallel fracturing and/or faulting within the layered metamorphic rocks and/or stratigraphic units with different chemical composition, weathering susceptibility, fracture style or other distinct characteristics which combine to produce a feature of this size and scale.

d) Additional NE-striking grooves have been interpreted on the bedrock surface and likely also correlate with underlying fractures and/or stratigraphic zones in bedrock of this orientation.

e) Potential locations for fracture systems in the underlying bedrock beneath some of the major NW- and NE-striking grooves on the bedrock surface are sketched on the attached figures.

f) While the exact location, depths, strike lengths, spacing, and density of such fractures is not known, there is a reasonable likelihood that an interconnected network of this type, augmented by shallow sheeting fractures, which are not expressed on the bedrock surface, but are highly likely to be present, allow for groundwater and contaminant migration within bedrock. While the monitoring well network is not particularly robust, particularly in bedrock, all hydrostratigraphic units show northwesterly-directed hydraulic gradients from the Main Street DAPL area to the MMB area and associated wetlands to the northwest. Contaminants appear to have the ability to travel along strike in the foliation-parallel fracturing until they connect with northwest-striking fractures which collect and direct flow to the hydraulically downgradient areas. Groundwater and contaminant transport is also likely facilitated in shallow groundwater by shallowly-dipping sheeting fractures which generally mimic topographic elevation and slope down to the northwest.

g) Additional monitoring points are needed in many areas at many depths, most acutely in the areas immediately downgradient of the Main Street DAPL area, particularly to the northwest.

4. *__3-D representation of fracture system at source-area scale__*: A 3-D hydrogeologic model which incorporates the level of hydrogeologic complexity and faulting/fracturing at the scale of the Main Street DAPL pool is needed to inform a TIE, rock matrix sampling as well as an appropriate spectrum of potential Site-restoration remedial scenarios. The current work plan is not sufficient for any of these purposes, particularly TIE, as the "matrix" results cannot currently be placed into a Site-specific context at the scale of interest. Since the system is three-dimensional, a three-dimensional framework will be needed to: a) appropriately locate and plan the test; and b) interpret the results *in 3-D context*. It would be premature for EPA to approve the current workplan without the appropriate supporting foundation. Instead, Olin shall revisit the rock sampling effort and/or other methods for evaluating matrix diffusion/back-diffusion strength at a future project phase once a technically robust 3-D understanding of the fracture network and the associated DAPL mass is produced at the source-area scale, for the Main Street DAPL area, and other critical source zones such as the Containment Area, Jewel Drive DAPL area, and Maple Meadow Brook diffuse area.

5. *__Matrix and weakly-fractured regions__*: The work plan is insufficiently specific regarding the conceptualization and treatment of "matrix" and "weakly-fractured" areas of the rock mass. For example, on page 6, the work plan discusses,

   "*potential long-term importance of intervening weakly fractured bedrock as a contaminant storage reservoir that is part of the fabric of the bedrock system. Both the major dominant fractures and the weak fractures are adjacent to un-fractured rock matrix. For convenience we shall simply refer to this as the bedrock fracture-matrix structure. The weakly fractured bedrock, is typically not studied since these types of fractures do not yield sufficient quantities of water to allow sampling by conventional means. These zones of weakly fractured bedrock not only intersect the boreholes where studied but also the fracture planes where the bulk of groundwater is transmitted. It is unknown whether the rock matrix adjacent to these weak fractures, or within the weakly fractured zones, is also impacted by diffusion to a degree that would contribute to the long-term retention of contaminant mass in the groundwater system. If the weakly fractured or low transmissivity bedrock in fact contains high dissolved concentrations of NDMA, then the rock matrix adjacent to those fractures is likely impacted as well."*

   In the foregoing discussion, EPA does not believe that there is a significant practical difference between "dominant fractures" and "weak fractures" as both are elements of the interconnected fracture network and must be considered apart from "matrix," which (by definition) is that portion of the rock mass devoid of fractures and is characterized by inherent primary rock porosity. While the outer fringes of specific fractures and more complex systems of interconnected fractures, large and small, are generally "adjacent to the unfractured rock matrix," it is theoretically imprecise and potentially misleading to refer to the "*bedrock fracture-matrix structure*" as a single entity. Our evaluation of the available data strongly suggests that areas of weak fracturing are generally associated with areas of more significant fracturing (described by Olin/Wood as "dominant" fractures). Contamination found within smaller "weak" fractures is likely to have migrated to such locations via larger dominant hydraulically-significant fractures. As such, matrix processes may have less importance in fractured regions, which even in the case of smaller fracture networks, are dominated by *fracture-dependent processes.* Conversely, *matrix-dependent processes* require *unfractured matrix.* It would therefore be inappropriate, theoretically incorrect, and misleading to assess the "*bedrock fracture-matrix structure*" as a single composite entity in relation to matrix diffusion alone. Instead, technically defensible assessments of matrix diffusion must provide sufficient resolution to assess both matrix- and fracture-dependent processes independently.

6. EPA has requested additional clarifications and edits. Comments that have not been fully addressed, comments that require additional discussion, and comments not included in the previous general comments, are included below.

   a. Comment 1, resolution of the mapped northern boundary of the Main Street DAPL pool: Olin has responded that the resolution of this area is well defined by soil borings and seismic lines. Olin shall provide a numerical value, such as within 10 feet/20 feet.

   b. Comment 1, centroid of NDMA mass within the bedrock matrix: part of the evaluation of diffusion within the bedrock matrix will require an initial "maximum concentration." The location of this point may have an impact on contaminant transport. The configuration of contamination in the bedrock shall be considered and addressed in the final report.

   c. Comment 3, number of testing locations: Olin contends that only a single borehole is needed in an area of highly contaminated bedrock. However, bedrock has not been extensively evaluated to date (only 5 bedrock boreholes have been installed in the immediate vicinity of the DAPL pools) and available data suggest that the bedrock fracture regime and lithology vary significantly between boreholes.

7. The sample collection procedure outline/decision tree in the Revised Plan is complicated and may be difficult to effectively and consistently implement/follow in the field. It appears that many components of the sample collection procedure are subject to the discretion and interpretation of individual field sampler(s). Sufficient notice shall be provided ahead of performing this work in the field so that EPA's chief hydrologist and oversight consultant hydrologist from Nobis Engineering can be present.

8. The responses to comments in the Revised Plan include statements about previous investigations that are incorrect or in dispute. For example, in response to the Nobis comment #6, Wood states that their investigations "clearly demonstrate" that the bedrock in the containment area is competent to depths greater than 100 feet. As described in EPA's May 30, 2018 memorandum on the results of the containment area bedrock borings, data clearly indicate that fractured, incompetent shallow bedrock was present in both borings. The borings in this investigation were also not properly positioned or oriented to sufficiently evaluate potential fractures. One of the observed water-bearing fractures also has the potential to extend to within the DAPL pool boundary. These data indicate that, despite Wood's assertion, available data do not indicate that the bedrock is competent in the containment area.

SPECIFIC COMMENTS

1. **Section 2.0, Background and Objectives.** This section includes a problem statement and discussion of bedrock matrix diffusion as presented in published studies. This discussion focuses solely on the transport mechanisms associated with matrix diffusion, but does not include a discussion of the source chemicals studied. It's EPA's understanding that similar studies have focused on chlorinated solvents such as TCE, PCE and vinyl chloride, which are common source chemicals. The source chemical proposed for study at the Olin Site is NDMA, which may have significantly different

physical and chemical properties than the well-studied chlorinated solvents. Olin shall include the specific equation used and explanation of individual parameters selected (such as the source and destination concentrations) to determine the NDMA migration distance based on Fick's first law. Also, Olin shall include a discussion of the properties of NDMA in the context of its ability to diffuse into the rock matrix. Or, in other words, can Olin/Wood say if NDMA is more or less subject to rock matrix diffusion than the well-studied chlorinated solvents?

2. **Section 2.2, Problem Statement,** Page 5 of 15, 4th ¶; The text states, "*The intervening blocks of bedrock defined by the intersection of these major fracture sets are not monolithic and are commonly weakly fractured based on current borehole logging information. The weakly fractured bedrock and the hydraulically dominant fractures are connected and are both in intimate contact with the adjacent, un-fractured, rock matrix.*" This generality may not hold for *all* cases. For instance, Olin/Wood has continually asserted that the "quartzite" rock type near the containment area is so tight that it effectively contains the DAPL in contact with and above it. Further, a recent borehole drilled in this area, OC-BB-2018-2 was figuratively described during a recent telecon as a "socket," meaning that it is interpreted to be essentially "tight" and minimally fractured over much of its length. Following Olin/Wood's overall arguments, one could effectively contend that this area is in fact characterized by "monolithic" blocks of rock separated by intersecting sparsely-occurring fractures. In any case, clearly there are areas of the Site where fracturing is much more intense than at others, and "monolithic" blocks of less fractured rock exist to some degree. Conversely, in more heavily fractured areas, EPA does not believe that there is a practical difference between "hydraulically dominant fractures" and "weakly fractured bedrock" in contact with it – both are elements of the interconnected fracture network and must be considered apart from "matrix" which (by definition) is that portion of the rock mass devoid of fractures characterized by primary rock porosity. Please see general comments 5 and 8 above.

3. **Section 2.2, Problem Statement,** Pages 5 and 6 of 15; The text states "NDMA has a reported diffusion coefficient of 0.84 cm2d-1 (GSI Chemical Data Base. https://www.gsinet.com/en/publications/gsi-chemical-database/single/404-nitrosodimethylamine-n.html), which based on Fick's Law yields a migration distance of approximately 6 feet by diffusion processes over a 60-year period (the approximate time the DAPL pool has been present)." In addition to the diffusion coefficient cited for NDMA, please illustrate this assertion with a calculation which includes all the assumptions used and references to appropriate sources. It is important to note that this calculation essentially represents a testable hypothesis. Presuming a point of origin for matrix diffusion (such as a DAPL-filled fracture) can be identified and located in the field, this hypothesis can be tested by coring or other means into unfractured matrix at progressive distances from an identified NDMA source on site (e.g., DAPL in large-aperture fracture). Please see general comments, above. Also, please see specific comment 11 prepared for Appendix H of the Draft OU3 RI Report, which is repeated here for convenience:

   Appendix H, Conceptual Numeric Model Report, Model Results, Page 5, 2nd ¶; The report states: *"Figures 5 and 6 show the predicted NDMA concentrations 50 years after formation of the DAPL pool for the same basic set of input parameters and assumptions. The advective transport component results in more widely spread NDMA presence in both the overburden and the bedrock while the impact of matrix diffusion in the bedrock is generally less than 5 additional feet except directly below the DAPL Pool where it is between 5 and 10 feet."* These predictions shall be used to create testable hypotheses regarding the observed length scales to which NDMA has invaded the bedrock matrix after roughly 50 years. The rock coring program envisioned by Olin could help elucidate this data gap, but the strength of any such assessments will rest on the quality and robustness of the understanding of the Site-specific fracture networks beneath and surrounding the Main Street DAPL pool. The goal is to interrogate unfractured matrix at a variety of definable distances away from known fractures to validate and or modify/refine the model's assessment of matrix diffusion. See general comments, above.

4. **Section 2.2, Problem Statement,** Page 6 of 15, 1st ¶; The text states, "*Hence, to understand and estimate groundwater remedy duration, it is critical to estimate and/or quantify the contamination in rock matrix.*" EPA concurs with this statement. Further, EPA believes that it is also critical to have the ability to discriminate and differentiate between contamination in "rock matrix," and that contained in fractures, both major and minor. The challenge then becomes how to identify a test location where progressive measurable distances away from a known source (such as a DAPL-filled large-aperture fracture) may be accurately quantified with respect to contaminant mass contained in fractures or matrix. EPA contends that contaminant mass in small-scale fracturing in contact with larger-aperture fractures is representative of fracture-hosted contaminant mass rather than matrix, particularly if sampling and testing methods have insufficient ability to discern differences at the appropriate scales and level of resolution. See also general comments above, and specific comments, below.

5. **Section 2.2, Problem Statement,** Page 6 of 15, 2nd ¶; The text states, "*These approaches do not consider the potential long-term importance of intervening weakly fractured bedrock as a contaminant storage reservoir that is part of the fabric of the bedrock system. Both the major dominant fractures and the weak fractures are adjacent to un-fractured rock matrix. For convenience we shall simply refer to this as the bedrock fracture-matrix structure. The weakly fractured bedrock, is typically not studied since these types of fractures do not yield sufficient quantities of water to allow sampling by conventional means. These zones of weakly fractured bedrock not only intersect the boreholes where studied but also the fracture planes where the bulk of groundwater is transmitted. It is unknown whether the rock matrix adjacent to these weak fractures, or within the weakly fractured zones, is also impacted by diffusion to a degree that would contribute to the long-term retention of contaminant mass in the groundwater system. If the weakly fractured or low transmissivity bedrock in fact contains high dissolved concentrations of NDMA, then the rock matrix adjacent to those fractures is likely impacted as well*." While these statements are generally correct, the key question is to what length scale from a fracture has the rock matrix been invaded via processes of *matrix diffusion*. However, it is not theoretically correct to assign long-term retention of contaminant mass from "weakly fractured rock" to the bedrock "matrix" as Olin/Wood implies. See previous comment and general comments, above.

6. **Section 2.2, Problem Statement,** Page 6 of 15, 3rd ¶; Referencing GW-406BR, several hundred feet to the northeast of the Main Street DAPL pool, the text states, "*These four fractures clearly dominate the hydraulics of the borehole based on HPFM data; however inspection of the calliper, ATV and optical logs reveals that more than 30 additional fractures are present, many very fine in character, others more conspicuous. All these additional fractures in addition to the four main transmissive fractures could be an integral part of the chemical mass storage behavior of this bedrock*."

   The area around GW-406BR is essentially devoid of additional bedrock fracture characterization. As such, "matrix" sample results collected from this location alone would have considerable uncertainty as to the spatial relationships and interconnection of the "minor" fracturing penetrated by the borehole and any larger fractures not directly intersected by the borehole. In other words, the three-dimensional context of this information is not known, and as such, the conclusions suffer accordingly. Please see general comments, above.

7. **Section 2.2, Problem Statement,** Page 6 of 15, footnote 1; the footnote draws parallels to the Eastern Woolen Mill Superfund site. The Site is weakly characterized with respect to bedrock in comparison to the Eastern Woolen Mill site, and further comparisons are therefore inappropriate. Please see general comments above.

8. **Section 2.3, Objective,** Page 7 of 15; The work plan summarizes the objective as follows, "*The overall objective of the proposed boring location (shown in **Figure 1**) is to verify conclusions of the numerical modeling, as suggested by USEPA during a technical meeting on February 7-8, 2018, by conducting rock matrix sampling at a location known to have high concentrations of NDMA in groundwater, and that has fracture characteristics of the geology near the Main Street DAPL pool. The preliminary conceptual 2-Dimensional (2-D) modeling to simulate the expected fate and transport of NDMA in fractured bedrock was based on data associated with the Main Street DAPL pool."*

   As discussed in previous comments above, and for the Draft OU3 RI Report and related modeling appendix, a variety of issues have been identified with the CSM which was used to construct the numeric model. Until the CSM is expanded and improved, it is not appropriate to "validate" conclusions drawn from the associated numeric model. Specifically, our independent analysis leads to a determination that fracture characteristics of the geology near the Main Street DAPL pool are insufficiently understood at present to inform the numeric model. The basis for the location shown on Figure 1 is also not clear. Additional specific issues are as follows:

9. **Section 2.3, Objective,** Page 7 of 15, 3rd bullet; The task of "*Evaluating the distance at which NDMA can be detected in rock matrix from an identified fracture in the borehole*" can only be accomplished if the fracture spacing is much greater than the sample spacing. It is not clear that this will hold true for many situations based on sampling frequencies reported in other boreholes on the Site.

10. **Section 2.3, Objective,** Page 7 of 15, 4th bullet; The task of "*Developing a refined conceptual model of the frequency and vertical extent of NDMA impacts to the bedrock matrix in the borehole*" is insufficient and potentially misleading without the 3-D context of that data relative to existing fractures. In other words, what is the *horizontal extent and distribution* of NDMA relative to the *vertical extent and distribution* of NDMA determined from the borehole? A detailed 3-D understanding/model of the fracture system in the areas surrounding and including the rock mass where the test well(s) is to be located is a prerequisite to evaluating lateral and vertical distribution of NDMA or other COCs distribution relative to specific fractures.

11. **Section 2.3, Objective,** Page 7 of 15, 6th bullet; The task of "*Measuring NDMA concentrations in groundwater in weakly fractured bedrock in the borehole*," suffers from the problem of not knowing whether measured concentrations can be attributed to larger fractures, not intersected by the borehole, which are interconnected with and affect the weakly fractured bedrock (which *is* intersected by the borehole). A detailed 3-D understanding/model of the fracture system in the areas surrounding and including the rock mass where the test well(s) is to be located is a prerequisite to evaluating NDMA in weakly fractured bedrock in appropriate site-specific context.

12. **Section 2.3, Objective,** Page 7 of 15, 7th bullet; It is not clear how the task of "*Characterizing transmissivity of the entire borehole so that zones of low transmissivity can be identified and related to specific fracture features in the borehole*" will be accomplished. Olin shall clarify how these 1-D relationships would be correlated, or not, in the absence of a detailed 3-D understanding/model of the fracture system in these areas. It is easy to see how such correlations could introduce errors. As an example, a zone of unexpectedly high transmissivity in an area of minimal fracturing in the borehole may relate to a larger fracture interconnected with the zone which does not intersect the borehole.

13. **Section 2.3, Objective,** Page 7 of 15, 8th bullet; The task of "*Adapting and implementing commercially available methods (e.g., FLUTe liners) to sample and characterize groundwater in low transmissivity bedrock zones*" is important, but sampling strategies and interpretation of results need to be informed in context of a detailed site-specific 3-D model of the fracture system.

14. **Section 2.3, Objective,** Page 8 of 15, 1st, 2nd and 3rd ¶; Olin shall detail true-scale hydrogeologic cross sections parallel and perpendicular to hydraulic gradients which place the proposed location in proper context. Olin shall include relevant hydraulically-dominant fractures in their proper orientations on the sections. In addition, Olin shall clarify why it is desirable to locate a borehole to assess matrix diffusion in a location which is both down-dip and hydraulically downgradient of DAPL areas. At such a location, both advective and diffusive properties may have affected contaminant distribution. A simpler test of matrix diffusion would be to select an area directly hydraulically upgradient and up-dip of a DAPL area. Such a location would be dominated by diffusion processes.

15. **Section 3.1.1 Bedrock Coring, Sample Selection and Preparation;** A more rigorous and prescriptive SOP for installing steel casing is needed. For example, a minimum of 5-feet of unfractured core is needed prior to setting casing to avoid potential leakage and cross contamination issues. If significant rubble zones (more than a foot) or extensively weathered rock are encountered, how will this be addressed? Will a sample be attempted for these, or will they be skipped? Olin shall prepare a more rigorous casing installation SOP for EPA review. Also, the specific procedures for measuring and documenting added drilling water for coring shall be developed and circulated for EPA review.

16. **Section 3.1.1 Bedrock Coring, Sample Selection and Preparation,** Page 9 of 15, last bullet**;** The text states, **"***If weathered rock matrix is encountered, it will also be sampled in accordance with the frequencies described in the decision tree*." Olin shall define "weathered rock" in this context, and explain how it will be identified and addressed in the field.

17. **Section 3.1.1 Bedrock Coring, Sample Selection and Preparation,** Page 9 of 15, last bullet; (physical testing of core); The text states "*Up to four representative core specimens will be collected for physical characterization at an off-site accredited laboratory. Physical characterization will include density, porosity, and fraction of organic carbon.*" EPA shall be given the opportunity to provide input into the locations and depths at which such samples are to be selected from.

18. **Section 3.1.3 Sample Extraction and Analysis;** The text states "*Labelled isotope internal standard NDMA-D6 will be added to the solid matrix prior to adding the extraction solvent*." How will this be accomplished? Olin shall clarify. Also, why is moisture in the samples not expected? Would not water be expected to have invaded minute pore spaces via diffusive processes on similar time scales as NDMA or other chemicals? Olin shall clarify.

19. **Section 3.1.3 Sample Extraction and Analysis (Selection of Samples to be Analyzed), page 11 of 15, 1st ¶;** The text notes, "*The exact amount of samples to be analysed during first phase of analysis will be determined in the field, which will be focused on locations in proximity to fractures*." Olin shall supply additional detail/documentation as to how such determinations will be made in the field. Olin shall clarify what criteria will be assessed.

20. **Section 3.2 Borehole Structure and Hydraulic Conductivity;** The specific procedures for measuring and documenting water loss or gain to the core hole during drilling merit additional detail and documentation. Development shall remove all water introduced to the cored hole during drilling. Olin shall describe in further detail how specific conductivity and other field parameters will be used to determine whether groundwater samples are "generally representative of impacted zones."

21. **Section 3.3, 1st Paragraph;** Olin shall confirm that initial geophysical and other data will be shared with EPA prior to selecting FLUTe monitoring zones.

22. **Section 3.3; Low Transmissivity Bedrock Groundwater Sampling and Analysis;** While the proposal to modify FLUTe liners to allow for sampling of low transmissibility bedrock zones is interesting, EPA has concerns regarding whether sufficient sample volume will be collected in this manner. Olin shall provide preliminary calculations and assumptions which demonstrate a general proof-of-concept under certain assumptions of matrix permeability, etc.

23. **Figure 3** appears to show that rock core samples would be 4 inches long. DFN sampling of VOCs generally requires a "hockey puck" or less than 1-inch sample, and ideally, the sample length will be as short as possible. However, sampling for NDMA will require a larger volume. Olin shall confirm the minimum sample core length that can be used while still collecting a sufficient sample volume. Given the potential limited space between fractures to evaluate matrix diffusion, the length of individual samples should be minimized to the extent possible.

APPENDIX 5

EPA Comments on Draft Baseline Human Health Risk Assessment, Operable Unit 3 (March 30, 2018)
Olin Chemical Superfund Site, Wilmington, Massachusetts

GENERAL COMMENT

1. Section 6.0 of the Draft OU3 RI Report, summarizing the Draft OU3 Baseline Human Health Risk Assessment ("BHHRA"), states, "Aside from the scenarios evaluated, there are no other identified potential groundwater source areas in the Aberjona watershed within the extent of groundwater impacts associated with the Site (i.e., within the extent of OU3 groundwater)." The BHHRA does evaluate the existing potable wells with the Aberjona watershed, but fails to acknowledge the potential for future use of groundwater. EPA has commented numerous times that the BHHRA MUST include an evaluation of groundwater within the Aberjona watershed as a potential future potable source. Impacts to existing monitoring wells located within the Aberjona watershed are potentially significant and the MassDEP has determined that groundwater throughout the study area, including both the Ipswich and Aberjona watersheds, is of "HIGH USE AND VALUE," indicating the potential for potable use. Because the BHHRA continues to exclude this pathway, the BHHRA is disapproved. The BHHRA must be resubmitted with a full evaluation of an exposure pathway that includes the future use of the portion of the Aberjona watershed that lies within the OU3 study area as a potable source.

2. The revised Draft OU3 BHHRA shall be incorporated into the revised Draft OU3 RI Report (not a separate deliverable).

SPECIFIC COMMENTS

1. Section 1.0, page 1-2 - Olin defines "chemicals of interest" or COIs as "chemicals that have been associated with the former facility (as a raw material, product, or a constituent of waste streams or accidental releases) and that have been released to one or more environmental media." The BHRRA shall be modified to follow EPA guidance to identify "Contaminants of Concern" or COCs and shall use EPA's definition of COCs. NDMA, as well as other contaminants detected in DAPL, shall be included in the list of COCs.

2. Section 1.0 page 1-2: The first sentence of the last paragraph states: "There are no identified ecological receptor exposures to groundwater." This sentence should be removed because benthic infauna is exposed to groundwater as it emerges into surface water in the South Ditch. Sediment toxicity tests showed that there was toxicity in sediment samples to benthic test organisms even after the laboratory water overlying the test sediment in test containers had been purged of ammonia. The cause(s) of toxicity were not determined; however, given the initial concentrations of ammonia in the laboratory test containers, it is likely that ammonia in groundwater is contributing to the toxicity because they exceeded the National Recommended Water Quality Criteria for ammonia. In the absence of further ecological risk assessment and measurement of contaminants in groundwater adjacent to or under the bed sediments of the South Ditch to identify the chemicals that caused the toxicity, EPA concludes that the groundwater entering South Ditch poses an unacceptable ecological risk in South Ditch. Therefore, this document shall be revised to include this

conclusion and the Source Control FS shall develop remedial alternatives for reducing the toxicity to acceptable levels.

3. Section 1.3.3, pages 1-9 to 1-14. This BHHRA has used deed restrictions and the MCP's definitions of drinking water source areas to determine groundwater usage exposure scenarios. Based on this approach, groundwater within the Aberjona River watershed (except for private wells and a 500-foot radius around each of these wells), including the groundwater beneath most of the Olin property, is considered for non-potable uses only (irrigation, vapor intrusion, contact during excavation). The BHHRA includes the 2010 Massachusetts DEP Groundwater Use and Value Determination, which states: "Because a portion of the Site falls within a GW-1 area, (the Zone II to the north) and the close proximity to private drinking water wells to the southeast and the GW-1 potential drinking water source area to the south, and in light of the factors contained in EPA's Final Groundwater Use and Value Determination Guidance, the Department supports a high use and value for the Site area aquifer." Olin presented potable use exposure scenarios for private wells and the Ipswich River watershed aquifers and non-potable uses for the Aberjona River watershed aquifers. This approach is not consistent with the use and value determination made by the state. The BHHRA shall be revised to include an evaluation of the potential for potable water use in the Aberjona River watershed aquifer, using data from monitoring wells in this watershed not just the data from the existing private wells.

4. Page 1-14 of the report states that: "The Mass DEP document recommends that the risk assessment of the site area groundwater should include active and potential drinking water, vapor seepage into buildings, use of water in industrial processes, excavation into groundwater (worker exposure) and discharge to surface water. The BHHRA is including active and potential drinking water as well as vapor intrusion, use of groundwater for non-potable use (irrigation), and the RI/FS for OU1 and OU2 address the risk to surface water associated with groundwater/surface water interaction." The last sentence in this statement shall be deleted as the BHHRA and RI/FS for OU1 and OU2 fail to correctly assess these exposure scenarios. In addition, the revised RI Report and BHHRA shall be revised to include a correct risk assessment for potable use of groundwater in the Aberjona Watershed as directed in the comment above; for possible vapor seepage into current and future buildings; for worker exposure to groundwater used for industrial processes, for use of groundwater for irrigation, for exposure to groundwater during excavation and for exposure to surface water and sediments in the brook.

5. Section 1.5.6.2, Page 1-20 – The BHHRA has eliminated off-property vapor intrusion as a pathway of concern because the only exceedances of VISLs were CVOCs considered not Site-related and petroleum-related chemicals that are either "low" or can be attributed to off-property sources. The BHHRA shall document these non-Site-related, "low," and off-property sources.

6. Section 1.5.6.2, Page 1-20 – As requested by EPA, the BHHRA includes a potential drinking water scenario using data collected from DAPL. However, the document repeatedly argues that this is an improbable scenario because the DAPL is so badly contaminated that no one would use it as a drinking water source (it is green/black in color…). All reference to how improbable the scenario is shall be deleted from the BHHRA.

7. Section 2 - Groundwater data used in BHHRA calculations includes sampling data between 1995 and present. In general, EPA guidance recommends using data from the most recent sampling. The goal is to have at least 10 results to calculate statistically valid 95% UCLs using ProUCL. Data should be limited to more recent data where possible. Monitoring well data included data collected between 2010 and 2017. Many of those wells were sampled most recently during the comprehensive 2010 RI monitoring rounds. However, some wells (for example GW-24, which appears to have been sampled 18 times between 2010 and 2017) have been sampled multiple times. For such monitoring wells, the most recent 1 to 2 rounds of data shall be used unless older rounds are being included to capture the most recent analysis of particular COCs. Private well data included data collected between 1995 and 2017. There are quarterly data going back many years. Data from the last 2-3 years only shall be used to represent current conditions. Town well data included data collected in 2003 and earlier. Because there is no more recent data, the use of this older data from the town wells for COPC selection purposes is acceptable. Data from the former Sanmina property were collected in 1997 through 2004. Because there is no more recent data, the use of older data from the Sanmina wells is acceptable; however, limit that data to the two most recent years (2003 and 2004).

8. Section 2.3, Page 2-17 – The BHHRA assumed that detections of hexavalent chromium in groundwater were false positives. Therefore, the RSL for chromium was used to evaluate total chromium analytical data. Hexavalent chromium was detected in some shallow overburden wells off-property and consistently detected in bedrock in the southwest portion of the Site and therefore shall not be eliminated from consideration in the risk assessment. The BHHRA shall be revised accordingly.

9. Section 3.2.1, page 3-4 – The BHHRA states that EPCs have been calculated for each of the residential wells where NDMA was detected. There are private wells where NDMA was not detected, but other potentially site related contaminants (chloride, sulfate, nitrogen as ammonia) were. EPA acknowledges that, as discussed in the uncertainty section, there are no currently available EPA tapwater regional screening levels (RSLs) for these contaminants, no applicable toxicity values, and consequently no risks calculated. The BHHRA shall include an explanation (perhaps including this information and referral to the uncertainty section) of why EPCs and risks were not calculated for these private wells.

10. Section 3.2.1, pages 3-4 and 3-5 – Groundwater data collected from monitoring wells from the core of the plume(s) were used in calculating EPCs for the Ipswich River watershed and Aberjona River watershed overburden and bedrock. The text indicates locations of selected wells from the core of the Ipswich River watershed are shown on Figures 2.1-1 and 2.1-2. The text indicates locations of selected wells from the core of the Aberjona River watershed are shown on Figures 2.1-4 and 2.1-5. These wells shall be highlighted and encircled on the figures. The BHHRA shall clarify the criterion used to identify which wells were selected as representative of the core of the plumes.
    a. Ipswich River Overburden – GW-84D, GW-85D, GW-86D, and GW-87D
    b. Ipswich River Bedrock – GW-103BR, GW-61BR, GW-62BR, GW-62BRD, GW-62BRDD, GW-62BRDS, and MP-5#03
    c. Aberjona River Overburden – GW-10DR, GW-55D, GW-69D, GW-202D, GW-307, MP-1#07, MP-1#08, MP-1#14, MP-2#06, and MP-2#07

d. Aberjona River Bedrock – GW-202BRD, GW-202BRS, GW-406BRD, and GW-406BRS

11. Section 3.2.2, pages 3-5 and 3-6 – Shower EPCs - To calculate inhalation exposures for residential potable water use, the BHHRA is using a showering model (Foster & Chrostowski, 1987) used by MassDEP in developing their MCP-GW-1 standards; rather than using the inhalation of vapors during household water use model (Andelman, 1990) currently used in developing the inhalation portion of the EPA tapwater RSLs. Both models have been used in HHRAs over the last 20+ years. The advantage of the Andelman model is its simplicity, but also that it covers exposures to volatiles from all household water uses (showering and bathing, but also laundry, cooking, dishwashing, etc.). The Foster & Chrostowski model is strictly a model for exposures while showering. By using the Foster & Chrostowski model, the BHHRA does not include a 24 hr/day exposure to household air created by a variety of household water uses, but rather only evaluates inhalation exposures for the few minutes a day while showering. The uncertainty section (Section 6.2.2.1) discusses these two models and the justification for selecting the shower model. The BHHRA shall also present, in the uncertainty section, risks using the Andelman model with an adjusted volatilization constant K at the low end of Andelman's range as a counterpoint to the shower model.

12. Section 3.3.1, page 3-8 and Table 3.1-1 - Exposure Assumptions - Because of the selection of the Foster & Chrostowski model, inhalation exposure times are limited to time spent in the bathroom during showering (EPA default showering/bathing time is 43 minutes (0.7 hr) for adults and 32 minutes (0.54 hr) for children), as opposed to 24 hr/day exposure to household air. In addition, the BHHRA assumes the shower is only running for 1/2 that time and so uses 1/2 the EPA recommended default showering exposure times within the model to develop the air concentration. Exposure times are still shown on Table 3.1-1 as the default values; however, it is within the calculation of the air concentration that this reduction in time has been carried out ("time in shower" on Table 3.1-1). Although this may be appropriate for a CTE evaluation, the model shall use the full default exposure time to calculate the indoor air EPC while showering for an RME evaluation.

13. Section 5.1.3, page 5-3 - The text states: "Risks at or below 10^{-4} (upper end of the NCP risk range) do not generally warrant a response action. Risks greater than 10^{-4} generally warrant development and evaluation of remedial alternatives." (citation omitted). This text shall be replaced with the following statement consistent with EPA policy: "CERCLA requires regulatory risk management review within a targeted cancer risk range of 1E-06 to 1E-04. Risks below 1E-06 (less than 1 in 1 million) are generally considered to be acceptable by EPA. Risks greater than 1E-04 (1 in 10,000) are generally considered to be unacceptable."

14. Section 5.2.2.6, pages 5-9 and 5-12 – On-property construction workers are exposed to contamination in both groundwater and soils. The BHRRA shall include cumulative risks for construction workers exposed to both these media. Risks for soils were calculated under OU1. Those calculated risks shall be brought forward and the BHRRA shall present total cumulative risks for these receptors.

15. Section 5.2.3.2, pages 5-11 and 5-12 – EPA's current goal for lead evaluations is that no more than 5% of individuals exceed the target blood lead level of 5 µg/dL. The BHHRA shall

provide the percent of exposed children with estimated blood lead levels exceeding the target level of 5 µg/dL.

APPENDIX 6

EPA Comments on Draft Operable Unit 1 & Operable Unit 2 Feasibility Study (March 30, 2018)
Olin Chemical Superfund Site, Wilmington, Massachusetts

GENERAL COMMENTS

1. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed not to separate the FS report by OUs. EPA's letter stated: "Consistent with EPA Guidance for conducting Feasibility Studies, the FS for OU1, OU2 and OU3 due to EPA on March 31, 2018 shall be structured with source control alternatives addressing all sources of contamination and groundwater response alternatives. The source control alternatives shall address the Containment Area and DAPL as ongoing sources. The groundwater response alternatives shall address restoration of the aquifer and management of migration. The 2018 FS shall not be divided by OUs, but shall address source control actions and groundwater response actions separately for the entire Site." The March 30, 2018 drafts of the OU1/OU2 and OU3 FS reports have failed to meet these requirements; therefore, these submissions do not comply with EPA Guidance. As noted in EPA's comments on the Draft OU3 RI Report, there is sufficient data to demonstrate that the Site contains significant uncontrolled sources in all of the operable units ("OUs"). OU1 (the Olin Property) contains ongoing sources including but not limited to the material in the Containment Area. OU2 (off-property sediment and surface water) also has ongoing sources of groundwater contamination that have yet to be controlled. OU3 (the groundwater) has DAPL (both on and off property) acting as an ongoing source of contamination to the rest of the aquifer, and contaminated groundwater that continues to migrate. However, there is insufficient data to develop a complete conceptual site model for the bedrock and to evaluate alternatives that restore the aquifer to its beneficial use. Therefore, Olin shall develop a FS focused to clearly identify and evaluate source control alternatives for all OUs in accordance with EPA guidance (in one FS report, not three separate ones) ("Source Control FS"). These alternatives shall include alternatives that remove DAPL from all DAPL pools, that consider in-situ treatment technologies to reduce these sources, that include groundwater response alternatives such as extraction and treatment to contain the overburden and shallow bedrock contamination, and that utilize slurry walls and capping options to contain the sources. Since there is insufficient information to support the development of a FS with a full range of groundwater response alternatives that restore the aquifer, EPA will develop a schedule for the submission of a Further Groundwater Response Action FS Report ("Further Groundwater FS Report") after sufficient data has been collected.

2. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed to provide a more robust analysis regarding the applicability of RCRA Subtitle C requirements for the Containment Area under CERCLA. Olin added a brief discussion of past abatement measures within the Containment Area to the FS reports; however, what has been provided is inadequate. Olin shall submit a Source Control FS Report which includes the following:

    – A more detailed discussion of the soils/contaminants that were historically removed from the Containment Area. This discussion should include how the materials were characterized (some as hazardous and some as non-hazardous), a description of why the hazardous wastes were characterized as hazardous, and a description of the sampling methods used to demonstrate compliance with the MCP soil objectives;

- A summary of the data collected concerning all materials (soils at depth and DAPL) that remain within the Containment Area;

- A discussion of whether TCLP testing was ever performed on the materials, and if not, an explanation of whether the available data demonstrates one way or another that the materials are hazardous under RCRA;

- A discussion on whether and where RCRA hazardous wastes were disposed of at the Site on or after November 19, 1980;

- A discussion of whether the facility ever operated under a RCRA hazardous waste permit; and

- A discussion of whether the DAPL pumped from the pilot program is manifested and disposed of as hazardous waste.

Based on this analysis, the Source Control FS Report shall contain a detailed discussion on whether and to what extent the RCRA Subtitle C requirements are either applicable or relevant and appropriate for the Containment Area. If the requirements are either applicable or relevant and appropriate, then, assuming that the alternative will not result in clean closure of the Containment Area, some of the proposed cap designs (pavement and Subtitle D cap) would not meet ARARs and shall be screened out of further analysis. Olin may also propose alternatives in which RCRA hazardous wastes in the Containment Area are removed (or treated) and couple that option with alternate cap designs.

3. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed to remove all statements from the FS report implying that EPA's approval of the OU1/OU2 RI Report constitutes the selection of a presumptive remedy for the Containment Area. Olin has failed to make these required changes. As stated previously by EPA, the selection of a presumptive remedy is not consistent with CERCLA and the NCP, and EPA's approval of the RI was not intended to circumvent the FS process required by the NCP. To comply with NCP, the FS shall look at an appropriate range of alternatives for the Containment Area including no action, excavation and off-site disposal, ex-situ treatment, in-situ treatment, and capping. Furthermore, ARARs for these alternatives must be identified and factored into the analysis appropriately as noted in General Comment 2, above. In the Source Control FS Report, Olin shall not have any statements implying the selection of a presumptive remedy for the Containment Area, and Olin shall evaluate an appropriate range of alternatives.

4. The Draft OU1/OU2 FS Report states that "The human health risk assessment indicates the Property overall is suitable for industrial/commercial use." As stated in EPA's December 7, 2017 Comment Letter, "It is not clear if this statement is true for the Containment Area as the OU1/OU2 FS does not include a robust discussion of the data available for soils collected at various depths within the Containment Area. Sampling of this area was limited by the existing cap to shallow samples. This sampling may not be sufficient to allow industrial/commercial use without further response actions such as removal or a cap. In addition, depending on the final remedy selected for the Containment Area, a land use control requiring EPA approval of any use to ensure such uses do not interfere with the remedy selected may be required." Olin's updated

Draft OU1/OU2 FS Report failed to address this comment. Olin shall revise the discussion of contaminants within the Containment Area as described in General Comment 2, above, and revise the discussion of the suitability of the Property for industrial/commercial use as noted by EPA.

5. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed to remove claims that an asphalt cap, RCRA Subtitle D cap, and RCRA Subtitle C cap for the Containment Area would be equally protective. Additionally, EPA explained that Olin inappropriately prepared the OU1/OU2 FS with the assumption that the intent of the permanent cap would be the same as the intent of the interim cap; that is, to reduce infiltration by directing precipitation away from the Containment Area rather than minimizing infiltration to the maximum extent possible. If the RCRA Subtitle C requirements are either applicable or relevant and appropriate, then, assuming that the alternative will not result in clean closure of the Containment Area, the intent of the final cap shall be to reduce infiltration to the maximum extent possible, and to prevent contaminated soils and DAPL from coming in contact with groundwater. In this framework, a RCRA C cap is significantly more protective than an asphalt or RCRA D cap. In the Source Control FS Report, Olin shall revise the discussion of the effectiveness of the three proposed cap types accordingly. Additionally, Olin shall provide detailed analysis supporting its rationale for why the remedial alternatives considered in the Source Control FS Report are protective and meet ARARs.

6. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed to expound upon the discussion of the slurry wall and its effectiveness. Olin's updated Draft OU1/OU2 FS Report does not provide adequate discussion of the construction and integrity of the slurry wall. In addition, based on EPA's review of water level and hydraulic head data, EPA has concluded that the slurry wall may not provide adequate containment in this area (see Specific Comment 11, below, for the full discussion). In summary, the data demonstrates that water is flowing in and out of the Containment Area in areas other than the equalization window/key within the wall. There are several factors that are likely the source of migration in and out of the area. First, since the slurry wall was not keyed into bedrock, groundwater and contaminants may migrate out of the area at the base of the wall. Second, due to the nature of how this type of wall is constructed, it is possible that the wall itself could have construction defects or voids which may allow water and contaminants to flow in and out of the area. Third, as noted in comments on the Draft OU3 RI Report, EPA has concluded that the bedrock beneath the Containment Area is likely weathered and fractured based on several lines of evidence. Finally, the window/key that was designed into the wall to release hydraulic head pressure, acts as a conduit for groundwater and contaminants to migrate out of this area. These issues create considerable uncertainty with respect to the effectiveness of the slurry wall and interim cap as adequate source control measures for this area of the Site. It is also important to note that the construction of this slurry wall and the interim cap did not receive final approval from MassDEP as they shared the same concerns. Olin shall include in the Source Control FS Report a discussion of these issues and the uncertainty they present. Olin shall also include a discussion of the water level and hydraulic head data as presented by EPA in Specific Comment 11, below, as evidence of the uncertainty that exists. In addition, the Source Control FS Report shall include alternatives that further minimize releases from this area, including alternatives that improves the effectiveness of the current system (slurry wall and cap) and alternatives that remove or treat the remaining source material in this area.

7. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed to expand upon the discussion of the health risk from TMP in soils, and to lay out alternatives that prevent vapor intrusion. In the updated Draft OU1/OU2 FS Report, the discussion regarding mitigating the health risk from TMP in soils remains too brief. Olin shall expand upon this discussion so that it can be carried through all alternatives in the FS. Olin shall present and lay out alternatives that prevent vapor intrusion; it is not adequate to make only general statements that VI risk will be addressed if future development occurs in potential VI exposure areas. There must be analysis of alternatives for options that control the potential exposure routes. In the Source Control FS Report, Olin shall present and lay out alternatives that prevent vapor intrusion in areas where it may be a concern (including the Containment Area).

8. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), EPA directed Olin to modify the Remedial Action Objectives ("RAOs") for OU1 and OU2 in the FS. The revised RAOs remain inadequate, and shall be revised as follows for inclusion in the Source Control FS Report:

   - The RAO for vapor intrusion, in the updated Draft OU1/OU2 FS Report, is stated: "Mitigate potential impacts to public health resulting from soil vapor intrusion into future buildings that may be constructed in BBHRA EA1, EA3, and EA7."

     This RAO discounts potential vapor intrusion concerns at other areas of the Site, such as the Containment Area. Olin shall revise this RAO to state: "Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the Site."

   - The RAO for surface soil and sediment, in the updated Draft OU1/OU2 FS Report, states: "Remediate sediments and surface soil to conditions that mitigate ecological receptor exposure and/or potential adverse population effects associated with chromium and BEHP in Lower South Ditch sediment and BERA EA5 surface soil at concentrations associated with possible adverse population effects."

     Olin shall revise this RAO to state: "Restore soils and sediments to pre-release/background conditions to the extent feasible, at a minimum to levels that will result in self-sustaining benthic communities with diversity and structure comparable to that in appropriate reference areas."

   - The RAO for surface water, in the updated Draft OU1/OU2 FS Report, states: "Achieve national Recommended Water Quality Criteria for aquatic life for ammonia and chromium in South Ditch surface water."

     This RAO discounts other contaminants which may exceed the NRWQC. Olin shall revise this RAO to state: "Restore surface water to national recommended water quality criteria for the contaminants of concern."

   - The RAO for the Containment Area, in the updated Draft OU1/OU2 FS Report, states: "Installation of a permanent cap over the Slurry Wall Containment Area based on the recommendations presented in the Final OU1/OU2 RI Report (AMEC, 2015) approved by the USEPA (USEPA, 2015). The cap would continue to permanently minimize infiltration into the Containment Structure. Installation of a permanent cap is also a binding contractual requirement under the current Purchase and Sale Agreement that exists for sale of the property."

As noted in General Comment 3, above, this statement implies that EPA's approval of the OU1/OU2 RI constitutes the selection of a presumptive remedy for the Containment Area. Consistent with the NCP, a range of alternatives shall be developed and evaluated for the Containment Area in the Source Control FS. This statement shall be removed from the text, and a full range of remedial alternatives shall be evaluated. The existence of a Purchase and Sale Agreement does not supersede the need for a full evaluation of remedial alternatives, nor does it preclude EPA from selecting a remedy that is protective of human health and the environment and achieves ARARs.

9. In EPA's December 7, 2017 comments on Olin's Draft Feasibility Study Report for OU1 and OU2 (October 31, 2017), Olin was directed to develop RAOs for soil, including soils in the Containment Area. Olin has failed to provide RAOs for soil in this Report, and shall provide RAOs for soil in the Source Control FS Report. Examples of applicable RAOs for soil include:

   - Prevent direct human contact/ingestion/inhalation with contaminated soils that exceed ARAR and risk-based standards;
   - Prevent soil leaching and resulting contaminant migration to groundwater in excess of leaching-based standards; and
   - Prevent migration of contaminated soil to wetlands and adjoining properties.

10. The updated Draft OU1/OU2 FS Report fails to address an area of PCB-impacted soil located in the former electrical substation area on the northwest portion of the Property identified by Olin during the RI. Olin concluded that the reported concentrations of PCBs do not pose a risk above CERCLA limits for current or future workers. The maximum concentration of PCBs in surface and shallow soils reported during the OU1/OU2 RI is approximately 13 mg/kg. Olin indicated that no further effort is required to address these soils. EPA does not agree with Olin's interpretation. In EPA's November 11, 2014 Conditional Approval Letter for the April 10, 2014 Draft Remedial Investigation and Risk Assessment Reports, EPA directed Olin to compile alternatives in the FS to include actions to address the PCBs in soil. Olin failed to respond to this request. Olin shall provide a full range of remedial alternatives which address soils that contain PCBs above 1 mg/kg in the Source Control FS Report.

11. Throughout this updated Draft OU1/OU2 FS Report, the Draft OU3 RI Report and the Draft OU3 FS Report, there are references to this Site being an MCP site. In some instances, these references imply that the work conducted under the MCP was acceptable or approved by MassDEP. The Site is no longer regulated under the MCP. Since the MassDEP's comments were not being adequately addressed by Olin and MassDEP was not satisfied with the work conducted, MassDEP requested that the Site be listed on the National Priorities List and addressed under CERCLA with EPA oversite. The documents should be corrected to provide an accurate summary of the Site's history. Furthermore, statements that imply work done under the MCP was sufficient shall be deleted.

SPECIFIC COMMENTS

1. Page ES-1 – Olin states: "Based on the conclusions of the OU1/OU2, RI report, this OU1/OU2 FS develops and evaluates remedial alternatives to address the following…Installation of a permanent cap over the OU1 Slurry Wall Containment Area." As addressed in General Comment 3, above, this statement implies that EPA's approval of the OU1/OU2 RI constitutes the selection of a remedy in the Containment Area. This statement shall be removed and a full range of remedial alternatives shall be evaluated for the Containment Area.

2. Page ES-1 – For required revisions to the RAOs, see General Comments 8 and 9, above.

3. Page 1-1, Section 1.0 – Olin states: "This revised OU1 & OU2 FS addresses groundwater interaction between OU3 and OU1/OU2." As noted throughout this comment letter, Olin has failed to adequately address the interaction of contaminated groundwater, surface water, and sediment. Olin shall submit a Source Control FS Report (as described in General Comment 1, above) which provides a more complete analysis in accordance with the comments provided.

4. Page 1-4, Section 1.3 – In discussing the RAM for Former Drum Areas A and B, Olin states: "Twenty-nine of the 163 drums were characterized as hazardous waste and were shipped off-site for disposal at a permitted hazardous waste facility." As discussed in General Comment 2, above, Olin shall provide additional details about these wastes (i.e., why they were characterized as hazardous) and the implications for what other hazardous wastes may remain in the Containment Area.

5. Page 1-5, Section 1.3, bullet 4: Olin has not provided sufficient data to support the claim made here regarding vertical hydraulic gradients within the Containment Area. EPA is aware of only one set of paired deep/shallow water levels measured in 2016 (which was not included in the Draft OU3 RI Report). Olin shall provide additional data to substantiate this claim.

6. Page 1-5, Section 1.3: Olin states that the Calcium Sulfate Landfill (CSL) is in the 25th year of a 30-year post-closure monitoring period. Section 2.1.2.7 of the Draft OU3 RI Report states that it is in the 30th year. Olin shall correct whichever of these statements is made in error.

7. Page 1-6, Section 1.3 – Olin shall provide a reference to a figure to show the Site surface water bodies.

8. Sections 1.4 and 1.5 – Olin shall submit a Source Control FS Report that includes a detailed discussion of the interaction of groundwater with surface water and sediments. The discussion shall include an analysis of the impacts this interaction has on contaminant fate and transport.

9. Page 1-7, Section 1.4.1 – Olin shall include a reference to a figure in the FS depicting TMPs below 10 feet bgs.

10. Page 1-5, Section 1.3 – Olin states: "The OCSS also contains a Slurry Wall/Containment Structure that was constructed in 2000/2001 as a RAM approved by MassDEP while the OCSS was regulated under the MCP. The location of the Slurry Wall/Containment Structure is shown on **Figure 1.3-1**. The purpose of the Slurry Wall/Containment Structure was to achieve a permanent source control measure for the on-Property DAPL Pool, consistent with requirements of the

MCP. The objective of this source control action was to eliminate, to the extent feasible, the on-Property DAPL source material as a source of dissolved constituents to groundwater." MassDEP notes that the slurry wall / Containment Area was only conditionally approved. MassDEP also notes that a reason for transferring the Site to USEPA was because conditions that were stated in the "conditional approval" letter were not being met. Olin shall revise accordingly.

11. Page 1-5, Section 1.3 – In the discussion of the slurry wall, Olin states: "The relatively flat internal gradients and lack of vertical gradients within the structure indicates the slurry wall is effectively isolating groundwater above the DAPL from groundwater outside the Containment Structure. Therefore, the Containment Structure is performing as designed as a source control measure for the on-Property DAPL Pool." EPA does not agree with this statement based on the data that is available concerning the slurry wall's performance. The equalization window allows for the continued release of contaminated groundwater, which itself prevents the Containment Area from serving as an effective source control measure for DAPL. Additionally, the data Olin has collected does not support the idea that there is no communication (flow) through or beneath the slurry wall. Monitoring has consistently shown that water table elevations outside of the slurry wall have a significant influence on the interior water table elevation. This strongly indicates there is flow occurring into and out of the Containment Area through either the slurry wall, the slurry wall/bedrock interface, through weathered bedrock under the slurry wall, or through bedrock fractures.

    An analysis of groundwater flow patterns and gradients within the slurry wall shows that the Containment Area is not functioning as intended. The slurry wall is intended to fully isolate the outside groundwater from the internal groundwater except through the equalization window. At the equalization window, flow can enter or exit the Containment Area depending on the flow gradients at the time. If the water surface is higher just outside the equalization window, flow is into the Containment Area. If the water surface just outside the window is lower, flow is out of the Containment Area. Overall, in Wilmington, high groundwater is generally around May 1st and low groundwater around October 1st every year. It follows that during the rising groundwater time (October through May) groundwater flow should be into the Containment Area via the equalization window. During the period of falling groundwater levels (May through October) flow should reverse outwards of the equalization window from the Containment Area. Roughly, about as much flow should exit the Containment Area as flowed in during the previous time-period, but variations will occur on wet and dry years. This can be visualized by a simple groundwater signal that increases part of the year resulting in flow into the Containment Area, and decreases part of the year resulting in flow out of the Containment Area.

    Within the Containment Area, if fully isolated from the outside water surface elevations, water surface contours should be semi-circles or semi-ellipses around the equalization window. Simply, a mound of water is spreading out away from the equalization window. Figure 11 of Olin's HPIT Phase II report, attached (see Appendix 3), presents this case for May 6, 2016 high groundwater condition. The groundwater elevations are a series of semi-ellipses contours around the equalization window. Conversely, a similar figure in October for low groundwater would have similar ellipses, but the lowest contour would be at the window and increasing elevation contours of semi-ellipses away from the window.

    Again, if the slurry wall is functioning as intended, points equi-distant north and south from the equalization window would have the same water surface elevation in the Containment Area.

However, a review of the figures contained Appendix E of the HPIT Phase II Report indicates a very different condition is occurring. Attached (see Appendix 3) are the figures with flow lines added to indicate flow direction on each figure. Flow directions should be either away from the equalization window or towards the window. However, that is not the case. The flow direction is more often a north to south direction, much like the outside flow field. Of note, PZ-24 in the southwest corner of the Containment Area always has the lowest water surface elevation, and GW-CA3S in the northeast corner has the highest most of the time. Clearly, the outside flow field is strongly influencing the water surface elevations in the Containment Area.

To further examine the water surface elevation data, the data from Appendix E of the HPIT Phase II Report figures were entered on a spreadsheet and plots made between two well points. This analysis as well as figures presenting data from the selected plots are attached (see Appendix 3). Groundwater elevations at GW-CA1 (at the window) are always higher than PZ-24 (the southwest corner of the Containment Area). This indicates that flow is always going from GW-CA1 to PZ-24. The only place for the flow to go at PZ-24 is through (or under) the slurry wall. Similarly, either there is no flow or flow is going from GW-CA3S (northeast corner of the Containment Area) to GW-35S (center portion of the Containment Area) eight out of nine times. Clearly GW-35S, being nearer to the equalization window, should show higher groundwater levels during part of the year than GW-CA3S. Again, there must be an additional flow source besides the window. Groundwater flow is occurring either through (or under) the north slurry wall. These findings indicate that a ‘tilt’ of the internal water contours is occurring due to the influence of the outside water table. The north side is higher and the south side is lower in the internal water table. So, the Containment Area is not isolated from the outside. Flow is occurring into the area from the north and out of the Containment Area in the south. The route of the flow is not known, but may be through the slurry wall, through the interface between the slurry wall and bedrock, through the weathered bedrock surface, or through the bedrock fractures.

In the Source Control FS Report, Olin shall include EPA’s analysis in this comment and remove all statements which imply that the slurry wall is serving as effective containment for DAPL and contaminated groundwater.

12. Page 1-6, Section 1.4.1 – The discussion of OU1 Soil is not complete without a more detailed analysis of soil within the Containment Area, as described in General Comment 2, above. Olin shall add a more robust analysis of contamination of soils remaining within the Containment Area, at all depths.

13. Page 1-7, Section 1.4.3 – “The current impacts to Lower South Ditch sediment are associated with historical releases to the ditch system and not ongoing discharge of dissolved constituents to surface water” and “Current data indicate that the former sediment excavation remedies in Upper South Ditch were successful and that remaining contaminated sediment resides in the un-remediated portions of Lower South Ditch.” Although EPA agrees that past releases have caused the majority of impacts seen in the Lower South Ditch sediment, EPA believes that current ongoing groundwater discharging to the South Ditch may be re-contaminating the sediment. EPA notes that the 42 day toxicity test concluded that high toxicity levels are currently present in sediments within the South Ditch. Olin shall revise these statements in the Source Control FS Report to include the possibility of ongoing contamination to sediments

resulting from groundwater input, or Olin shall provide data showing such contamination is not a concern.

14. Page 1-7, Section 1.4.4 -- Olin states: "The current impacts to EA5 soil are associated with historical releases to the ditch system and not ongoing discharge of dissolved constituents to surface water." See Specific Comment 13, above; Olin shall revise accordingly.

15. Page 1-8, Section 1.5 – Olin states: "The volatiles (primarily TMPs) that have been reported in subsurface soils are not located at occupied structures, and therefore are not part of a complete vapor intrusion pathway." Olin must evaluate the potential for vapor intrusion pathways, regardless of the current existence of one. Olin shall evaluate the potential for soil vapor intrusion given potential future construction and develop alternatives to address the issue.

16. Page 1-8, Section 1.5 – Olin states: "Ammonia is highly water soluble and is therefore highly mobile, as its role in groundwater/surface water interaction." Olin shall correct the grammatical error (missing "is") in this sentence.

17. Page 1-8, Section 1.5 – Olin states: "Chromium in the South Ditch surface water is present along with elevated concentrations of aluminum and iron, and forms a precipitate, or flocculant (floc) that includes all three of these metals when groundwater discharges to the South Ditch surface water. Based on the data presented in the Final OU1/OU2 RI Report, hexavalent chromium was not identified in South Ditch surface water. Formation of the floc material is driven by changes in aqueous pH and is stable in the surface water environment. The floc material is mobile, in that storm water events result in the flushing of floc from the South Ditch to downstream locations. The floc material may also be sequestered in the South Ditch by leaf fall in the autumn and that material may be incorporated into the sediment of the South Ditch." See Specific Comment 13, above and General Comment 1, above; this statement illustrates the concern with ongoing contaminated groundwater discharge to South Ditch serving as a source of new contamination to South Ditch sediments.

18. Page 1-9, Section 1.6.1 – The BHHRA does not conclude that the soil within the Containment Area is below risk levels for construction workers, as indicated in this section. Conclusions in the BHHRA are based on the existing deed notice. Any Institutional Controls that may need to be a part of the selected remedy shall be presented in the Source Control FS Report. Olin shall revise accordingly.

19. Page 1-11, Section 1.6.3 – Olin states: "The human health risk assessment indicates the Property overall is suitable for industrial/commercial use." This statement is based on existing deed restrictions and shall be modified. Olin shall present any proposed Institutional Controls as part of the Source Control FS Report.

20. Page 1-10, Section 1.6.1 – Olin states: "In the future it is possible for redevelopment of the property to occur in this area and new industrial/commercial buildings could be constructed that would likely require institutional and engineering controls to address or eliminate VI pathways." As described in General Comment 7, above, Olin shall provide a robust analysis of alternatives for addressing this potential exposure pathway in the Source Control FS Report.

21. Page 1-11, Section 1.6.3 – Olin states: "Based on recommendations in the Final OU1/OU2 RI Report (AMEC, 2015) approved by the USEPA in July 2015 (USEPA, 2015), all remedial alternatives evaluated in the OU1/OU2 FS will include installation of a permanent cap over the OU1 Containment Area, the objective of which is to continue to permanently minimize infiltration into the Containment Structure." As addressed in General Comment 3, above, this statement implies that EPA's approval of the OU1/OU2 RI constitutes the selection of a presumptive remedy in the Containment Area. This statement shall be removed, and a full range of remedial alternatives shall be evaluated for the Containment Area.

22. Section 2.0 – The screening of remedial technologies to address OU1/OU2 soil, sediment, and surface water did not include technologies that might have potential application at the Site including soil freezing (potential containment method) and artificial controls (i.e., constructed culverts for certain areas of surface water). Solidification for sediment/soil and permeable reactive barriers for surface water should not have been screened out as potential remedial technologies. Olin shall revise this section for inclusion in the Source Control FS Report accordingly.

23. Page 2-2, Section 2.1.1 – As noted in General Comments 2 and 3, above, the updated Draft OU1/OU2 FS Report is lacking a robust discussion of contamination remaining within the Containment Area, and has inappropriately assumed a permanent cap will be the only component of the selected remedy. Olin shall revise the FS, and submit the Source Control FS Report, in accordance with General Comments 2 and 3, above. Section 2.1.1 shall be revised to include potential vapor intrusion issues associated with soils within the Containment Area.

24. Page 2-3, Section 2.1.2 – See General Comment 8, above, regarding required revisions to the RAOs for sediment, soil, and surface water.

25. Page 2-4, Section 2.1.4 – Olin states: "The temporary cap was originally designed to reduce infiltration into the Slurry Wall Containment Structure by directing precipitation away from the Containment Area through an internal drain leading to a retention basin that eventually discharges to South Ditch. The objective of the permanent cap is consistent with that of the temporary cap. Therefore, the RAO for the permanent cap over the Containment Structure is: Replace the temporary cap over the Slurry Wall Containment Area with a cap that will continue to permanently minimize infiltration into the containment structure." As discussed in General Comment 3, above, Olin shall evaluate a range of alternatives for the Containment Area, including no action, excavation and off-site disposal, ex-situ treatment, in-situ treatment, and capping. Developing an RAO specific to a plan for capping is not consistent with the NCP. Additionally, as discussed in General Comment 5, above, the stated objective of the permanent cap is inadequate; Olin shall revise accordingly as required by General Comment 5.

26. Page 2-5, Section 2.1.6 – Olin states: "The MCP contains a provision to avoid duplication of regulatory procedures and oversight at sites subject to multiple jurisdictions (310 CMR 40.0110). For example, the MCP states that conducting response actions at a site subject to CERCLA yields a site that is adequately regulated for purposes of compliance with the MCP (310 CMR 40.0000). Therefore, in accordance with the provisions of the MCP, the OCSS is considered adequately regulated under CERCLA. Therefore, the MCP is not considered an ARAR (neither applicable, nor relevant and appropriate) associated with response actions for OU1 and OU2." As stated in EPA's December 7, 2017 Comment Letter, this statement is not entirely accurate as written.

Olin shall remove this discussion from the all FS reports. The Commonwealth of Massachusetts will identify Massachusetts ARARs for this Site. Olin shall consult with the MassDEP and EPA before revising this section.

27. Page 2-6, Section 2.1.6.1 – Olin states: “As discussed in Subsection 1.6.1, the BHHRA did not identify any carcinogenic risks associated with OU1 and OU2 above the CERCLA acceptable risk range of 10-4 to 1—6 or a non-cancer Hazard Index of 1.” This statement is inaccurate as written as it leaves out soils in Lake Poly, the drum disposal area, the Containment Area, and Plant B. Olin shall revise accordingly. The updated Draft OU1/OU2 FS Report states that institutional controls are needed for EA1, EA3, and EA7; however, no details are provided. Olin shall include a description of any proposed Institutional Controls in the Source Control FS Report.

28. Page 2-6, Section 2.1.6.1 – Regarding the discussion of vapor intrusion risk, see General Comment 7, above.

29. Page 2-9, “Ecological PRGs for South Ditch Surface Water” – Note [b] states “…assuming that salmonid fish are absent as explained in the BERA.” As stated in EPA’s December 7, 2017 Comment Letter, representative species are tested and used to develop the criteria; it is not acceptable to choose which species are or are not present and further adjust the criteria. The chronic concentration for ammonia is 1.9 mg/l for a pH of 7 and a temperature of 20 degrees Celsius. This is the criteria value used for cleanup at the Halls Brook Holding Area Pond for the Industri-Plex Superfund site. Olin shall revise accordingly.

30. Page 2-9, “Ecological PRGs for South Ditch Surface Water” – The PRG for South Ditch Surface Water for HQ=1 for Chromium is 0.46 mg/l. There is an AWQC for Chromium VI which should also be used. The chronic criteria for Chromium VI is 0.011 mg/l (11 ug/l). Olin shall revise the table accordingly.

31. Page 2-10, Section 2.1.7.2 – Olin states: “The proposed remediation area is assumed to be one foot deep; however, the actual remediation will be based on the actual type of material encountered. That is, the remediation will address the organic sediment and soil associated with Lower South Ditch, but not the underlying mineral soils.” As stated in EPA’s December 7, 2017 Comment Letter, Olin shall provide further explanation for why the proposed remediation area is assumed to be only one-foot deep. Additionally, Olin shall provide an explanation for why contamination in underlying mineral soils will not be addressed. Please note that the cleanup must either meet an acceptable cleanup value for the sediments, or if not feasible to achieve the numerical standard, then a cap or other alternatives must be proposed as a component of the alternative. The revision shall also address the possibility of recontamination of sediments from groundwater and surface water. In the Source Control FS Report, Olin shall provide a figure indicating the respective groundwater areas that provide flow to the South Stream and EA5. For each contributing area, Olin shall present the concentrations of ammonia and chromium in these areas. A basic conceptual model of the groundwater flow area for both South Stream and EA5 shall be developed to determine the groundwater areas that must be addressed.

32. Page 2-10, Section 2.1.7.3 -- See General Comment 2, above, regarding the need to evaluate alternatives in addition to capping for the Containment Area.

33. Page 2-10, Section 2.1.7.4 – Olin shall provide a figure which delineates the area and associated volume of soil containing TMP concentrations above background.

34. Page 2-10, Section 2.1.7.5 -- See General Comment 7, above, regarding evaluation of VI risk and remedial alternatives.

35. Page 2-13, Section 2.3.2.1 – In the Source Control FS Report, Olin shall divide the discussion in this subsection into separate discussions for each soil and sediment source area. It is not clear which technologies were retained and which were eliminated for each soil and sediment source.

36. Page 2-13, Section 2.3.2.2 – Olin inappropriately dismisses all technologies for the treatment of surface water. Olin shall develop a series of remedial alternatives based on the technologies available so that they can be fully evaluated in the Source Control FS Report.

37. Page 2-14, Section 2.3.2.3 – See General Comment 7, above, regarding evaluation of VI risk and remedial alternatives.

38. Page 3-2, Section 3.1 – Olin states: "The USEPA-approved Final OU1/OU2 RI Report (USEPA, 2015) recommended installation of a permanent cap over the Slurry wall and Containment Area structure to replace the current temporary cap. The objective is to replace the temporary cap over the Slurry Wall Containment Area with a permanent cap to continue to minimize infiltration into the Containment Structure. Placement of a permanent cap over the Containment Area is also a binding contractual requirement under the current Purchase and Sale Agreement that exists for sale of the property. Therefore, remedial alternatives will consist of installation of a permanent cap over the OU1 Slurry Wall Containment Area." See General Comment 3, above, as well as Specific Comment 16, above. Olin shall revise accordingly.

39. Page 4-5, Section 4.2 – Olin states: "Therefore, re-vegetation of the excavated area would not be performed beyond the extent necessary as a temporary measure and the area would be allowed to recover naturally, which is the same as the approach used during the 2000-2001 remediation effort in Upper South Ditch." Olin failed to respond to EPA's December 7, 2017 Comment Letter which stated that "the alternative shall be revised to include a plan for replanting this area with appropriate species and monitoring its recovery." Olin shall provide a plan for replanting and monitoring of this area in the Source Control FS Report.

40. Page 4-7, Section 4.2.2 – Olin states: "The asphaltic cap would be designed and constructed to continue to permanently minimize infiltration into the Containment Structure. Historical disposal areas within the Containment Structure have been removed and listed or characteristic hazardous waste are not currently present in shallow soil (e.g., 10 – 15 ft) within the Containment Area. The DAPL surface within the Containment Area is approximately 35 ft below ground surface and deed covenants are currently in place prohibiting intrusive activities within the Containment Structure. As such, the cap is not intended to prevent exposure to hazardous waste, and therefore RCRA regulations are not directly applicable to a cap constructed to meet the intended objective." See General Comment 2, above, regarding required discussion of contaminants within the Containment Area. See General Comment 5, above, regarding the performance objectives of a final cap. If the Source Control FS Report concludes hazardous

waste will be left in place in the Containment Area (i.e., contaminated soils or DAPL) then the Containment Area / cap must meet RCRA regulations. Olin shall revise accordingly.

41. Page 4-8, Section 4.2.4 – Olin states: "The alternative provides long-term effectiveness…" EPA does not agree with this statement for reasons described in General Comment 5, above. This alternative would allow for continued dissolution and spreading of hazardous wastes within the Containment Area. Olin shall remove or revise this statement.

42. Page 4-11, Section 4.3.2 -- Olin states: "The objective of the cap is to replace the temporary cap over the Slurry Wall Containment Area with a cap to continue to permanently minimize infiltration into the Containment Structure. Historical disposal areas within the Containment Structure have been removed and listed or characteristic hazardous waste are not currently present in shallow soil (e.g., 10 – 15 ft) within the Containment Area. The DAPL surface within the Containment Area is approximately 35 ft below ground surface and deed covenants are currently in place prohibiting intrusive activities within the Containment Structure. As such, the cap is not intended to prevent exposure to hazardous waste, and therefore RCRA regulations are not directly applicable to a cap constructed to meet the intended objective." See General Comment 2, above, regarding required discussion of contaminants within the Containment Area. See General Comment 5, above, regarding the performance objectives of a final cap. If the Source Control FS Report concludes hazardous waste will be left in place in the Containment Area (i.e., contaminated soils or DAPL) then the Containment Area / cap must meet RCRA regulations. Olin shall revise accordingly.

43. Page 4-11, Section 4.3.3 -- Olin states: "The alternative provides long-term effectiveness…" EPA does not agree with this statement for reasons described in General Comment 5, above. This alternative would allow for continued dissolution and spreading of hazardous wastes within the Containment Area. Olin shall remove or revise this statement.

44. Page 4-11, Section 4.4.2 – Olin states: "The objective of the cap is to replace the temporary cap over the Slurry Wall Containment Area with a cap to continue to permanently minimize infiltration into the Containment Structure. Historical disposal areas within the Containment Structure have been removed and listed or characteristic hazardous waste are not currently present in shallow soil (e.g., 10 – 15 ft) within the Containment Area. The DAPL surface within the Containment Area is approximately 35 ft below ground surface and deed covenants are currently in place prohibiting intrusive activities within the Containment Structure. As such, the cap is not intended to prevent exposure to waste materials, and therefore RCRA regulations are not directly applicable to a cap constructed to meet the intended objective." See General Comment 2, above, regarding required discussion of contaminants within the Containment Area. See General Comment 5, above, regarding the performance objectives of a final cap. If the Source Control FS Report concludes hazardous waste will be left in place in the Containment Area (i.e., contaminated soils or DAPL) then the Containment Area / cap must meet RCRA regulations. Olin shall revise accordingly.

45. Page 4-15, Section 4.4.4 – Olin states: "The alternative provides long-term effectiveness…" EPA does not agree with this statement for reasons described in General Comment 5, above. This alternative would allow for continued dissolution and spreading of hazardous wastes within the Containment Area. Olin shall remove or revise this statement.

46. Page 4-17, Section 4.5.1 – Olin states: "Alternatives 2A, 2B, and 2C, Limited Action, Excavation with Off-site disposal, and Cap (Asphaltic, RCRA Subtitle C, or RCRA Subtitle D, respectively) are equally protective of human health and the environment. These three alternatives remove soil and sediment with COC concentrations above PRGs, continue to monitor surface water in South Ditch to achieve PRGs, and include a cap to continue to permanently minimize infiltration into the Containment Structure. Alternatives 2A, 2B, and 2C also include institutional controls to prevent a potential vapor intrusion exposure in future buildings at the site." This statement is inaccurate as outlined in the comments above. The three cap types are not equally protective, as explained in General Comment 5, above. The vapor intrusion alternatives are not adequately developed, as explained in General Comment 7, above. Olin shall revise accordingly.

47. Page 4-17, Section 4.5.4 – Olin states: "Alternative 1, No Action, is not effective in the long term. Alternatives 2A, 2B, and 2C, Limited Action, Excavation with Off-site disposal, and Cap (Asphaltic, RCRA Subtitle C, or RCRA Subtitle D, respectively) are equally effective in the long term." This statement is inaccurate and shall be removed or modified. See General Comment 5, above.

48. Tables 1, 2, and 3 – In these tables, Olin routinely screens out an individual technology because it may work for some COCs but not for others. It is common to develop remedial alternatives that include combined remedial technologies to achieve RAOs. The final remedial action may include different remedial technologies implemented in separate areas of OU1 and OU2. Olin shall revise all FS reports to include consideration of combining technologies; individual technologies should not be excluded during the preliminary evaluation.

49. Tables 2.1-1, 2.1-2 and 2.1-3 (ARARs Tables) - Olin shall replace Tables 2.1-1, 2.1-2, and 2.1-3 with new tables that use Appendix 6 - Attachment 1 (Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered Advisories, Criteria or Guidance) and Appendix 6 - Attachment 2 (Evaluation of Compliance with ARARs and TBCs for All Media) to these comments as a starting point for further development in the Source Control FS Report. Appendix 6 - Attachment 1 includes tables of potentially applicable or relevant and appropriate requirements ("ARARs") and "to be considered" advisories, criteria or guidance ("TBCs") that are location-specific, chemical-specific, and action specific. Appendix 6 - Attachment 2 includes tables that show the required level of alternative-specific ARAR analysis required for an FS. The tables included in Appendix 6 - Attachment 2 are provided as examples only to show the level of ARAR analysis required for each remedial alternative included in all FS reports. Due to the lack of remedial alternatives developed and evaluated in the Draft OU1/OU2 FS Report, the associated ARAR analysis is similarly deficient. All FS reports shall contain a detailed analysis of each remedial alternative that summarizes which requirements are applicable or relevant and appropriate (or TBC) for each alternative and describes how each alternative meets these requirements. When an ARAR will not be met, the basis for justifying one of the six ARAR waivers provided by CERCLA § 121(d)(4) shall be discussed. EPA reserves the right to provide further comments regarding the ARAR analysis completed in all FS reports.

50. Table 2.3-1 – Olin shall split this table in to multiple new tables, one for each source of contamination (TMPs, Containment Area, PCBs, south ditch sediment, EA5 soils, etc.). These sources may require separate treatment alternatives.

51. Table 2.3-2 – Given that the South Ditch is contaminated by shallow overburden groundwater, technologies screened must also include options to prevent or treat groundwater contamination. As stated in General Comment 1, above, Olin shall combine the FS reports into one Source Control FS Report so that they are not separated by operable unit, and in the process, address the impact of interactions between groundwater, surface water, and sediment.

52. Appendix A – Olin shall include figures showing areas of exceedances for all OU1/OU2 source areas, not just sediment and EA5 soils.

Appendix 6 - Attachment 1 - Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered Advisories, Criteria or Guidance - Location-Specific
Olin Chemical Superfund Site Feasibility Study
Wilmington, Massachusetts

[**Overall comment:** These tables (Appendix 6 – Attachment 1) are provided as a starting point for further development to show the potential ARARs that may apply to alternatives that are evaluated in the FS reports. For the purposes of the ARAR analysis to be conducted for the FS reports, and for preparing the tables in the FS reports, Olin shall consult the ARARs tables contained in the most recent RODs for Massachusetts sites and their supporting FS reports for additional potential ARARs. *See e.g.*, the 2017 Wells G&H Southwest Properties (OU4) ROD, https://semspub.epa.gov/src/document/01/622386; the 2015 Nuclear Metals, Inc. ROD, https://semspub.epa.gov/src/document/01/582996; the 2017 Wells G&H Southwest Properties (OU4) FS Report Addendum, https://semspub.epa.gov/src/document/01/620700; and the 2014 Nuclear Metals, Inc. FS Report, https://semspub.epa.gov/src/document/01/568423.]

Location Characteristic	Requirement	Citation	Status	Requirement Synopsis
Federal Standards				
Floodplain and Wetlands	Floodplain Management and Protection of Wetlands	44 CFR Part 9 (implementing EO 11988 and 11990)	Potentially Applicable	Federal Emergency Management Agency (FEMA) regulations that set forth the policy, procedure, and responsibilities to implement and enforce Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use. Requires the avoidance of impacts associated with the occupancy and modification of federally-designated 100-year and 500-year floodplain and to avoid development within a floodplain wherever there is a practicable alternative. An assessment of impacts to the 500-year floodplain is required for critical actions, which includes siting waste facilities in a floodplain. Requires public notice when proposing any action in or affecting a floodplain or wetlands.
Floodplain	RCRA Floodplain Restrictions for Hazardous Waste Facilities	42 USC § 6901 *et seq.*; 40 CFR § 264.18(b)	Potentially Applicable or Relevant and Appropriate	A hazardous waste treatment, storage, or disposal facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.
Floodplain	RCRA Floodplain Restrictions for Solid Waste Disposal Facilities and Practices	40 CFR § 257.3-1	Potentially Applicable	Solid waste practices must not restrict the flow of a 100-year flood, reduce the temporary water storage capacity of the floodplain or result in washout of solid waste, so as to pose a hazard to human life, wildlife or land or water resources.

Location Characteristic	Requirement	Citation	Status	Requirement Synopsis
Wetlands; Aquatic Ecosystem	Clean Water Act § 404, and regulations	33 USC § 1344; 40 CFR Parts 230, 231 and 33 CFR Parts 320-323	Potentially Applicable	For discharge of dredged or fill material into water bodies or wetlands, there must be no practicable alternative with less adverse impact on aquatic ecosystem; discharge cannot cause or contribute to violation of state water quality standards or toxic effluent standards or jeopardize threatened or endangered (T&E) species; discharge cannot significantly degrade waters of U.S.; practicable steps must be taken to minimize and mitigate adverse impacts; and impacts on flood level, flood velocity, and flood storage capacity must be evaluated. Sets standards for restoration and mitigation required as a result of unavoidable impacts to aquatic resources. EPA must determine which alternative is the "Least Environmentally Damaging Practicable Alternative" (LEDPA) to protect wetland and aquatic resources.
Wetlands	U.S. Army Corps of Engineers, New England District Compensatory Mitigation Guidance (09-07-2016)		Potentially To Be Considered	This Guidance is to be considered when compensatory mitigation to address impacts to federal jurisdiction wetlands is appropriate for a particular remedial activity.
Surface Waters, Wetland/Waterway Habitat for Endangered Species, Migratory Species	Fish and Wildlife Coordination Act	16 USC §§ 662-663; 40 CFR Part 6	Potentially Applicable	Requires consultation with appropriate agencies to protect fish and wildlife when federal actions may alter waterways. Must develop measures to prevent and mitigate potential loss to the maximum extent practicable.
Endangered Species	Endangered Species Act	50 CFR §§ 17.11-17.12; 50 CFR Part 402	Applicable, if such species are present	Requires action to avoid jeopardizing the continued existence of listed endangered or threatened species or modification of their habitat.
Historical/ Archeological Resources	National Historic Preservation Act	16 USC § 469 *et seq.*; 36 CFR Part 65	Applicable, if subject historical resources are present	When a federal agency finds, or is notified, that its activities in connection with a federal construction project may cause irreparable loss or destruction of significant scientific, pre-historical, historical, or archeological data, the substantive standards under the Act will be met.

Location Characteristic	Requirement	Citation	Status	Requirement Synopsis
Atlantic Flyway	Migratory Bird Treaty Act	16 USC § 703 *et seq.*	Applicable, if subject protected species are present	Protects migratory birds, their nests and eggs. A depredation permit issued by the U.S. Fish and Wildlife Service is required to take, possess, or transport migratory birds or disturb their nests, eggs, or young.
State Standards				
Wetlands, Surface Waters, Floodplains	Massachusetts Wetland Protection Act and Regulations	MGL c. 131, § 40; 310 CMR 10.00	Potentially Applicable	Regulations restrict dredging, filling, altering, or polluting inland wetland resource areas (defined as areas within the 100-year floodplain) and impose performance standards for work in such areas. Protected resource areas include: 10.54 (Bank); 10.55 (Bordering Vegetated Wetlands); 10.56 (Land under Water Bodies and Waterways); 10.57 (Land Subject to Flooding); and 10.58 (Riverfront Area).
Floodplains	Massachusetts Hazardous Waste Regulations, Location Standards for Land Subject to Flooding	310 CMR 30.701	Potentially Applicable	Any new or expanded hazardous waste storage or treatment facility (which only receives hazardous waste from on-site sources), the active portion of which is located within the boundary of land subject to flooding from the statistical 100-year frequency storm, shall be flood-proofed. Flood-proofing shall be designed, constructed, operated and maintained to prevent floodwaters from coming into contact with hazardous waste.
Wetlands, Aquatic Ecosystem	Massachusetts Water Quality Certification for Discharge of Dredged or Fill Material	MGL c. 21, §§ 26-53; 314 CMR 9.00	Potentially Applicable	For discharges of dredged or fill material, there must be no practicable alternative with less adverse impact on the aquatic ecosystem; appropriate and practicable steps must be taken to avoid and minimize potential adverse impacts to wetlands and land under water; stormwater discharges must be controlled with BMPs; and there must not be substantial adverse impacts to the physical, chemical, or biological integrity of surface waters. For dredging and dredged material management, there must be no practicable alternative with less adverse impact on the aquatic ecosystem; and if avoidance is not possible, then minimize, or if neither avoidance or minimization are possible, then mitigate potential adverse impacts.
Endangered Species	Massachusetts Endangered Species Regulations	321 CMR 10.00	Applicable, if subject species are encountered	Actions must be conducted in a manner that minimizes the impact to Massachusetts-listed rare, threatened, or endangered species, and species listed by the Massachusetts Natural Heritage Program.

Location Characteristic	Requirement	Citation	Status	Requirement Synopsis
Historical/ Archeological Resources	Protection of Properties Included in the State Register of Historic Places	MGL c. 9, §§ 26-27C; 950 CMR 71.00	Applicable, if subject historical resources are present	Projects must eliminate, limit, or mitigate adverse effects to properties listed in the State Register of Historic Places (historic and archaeological properties). Establishes coordination with the National Historic Preservation Act.
Area of Critical Environmental Concern	Massachusetts Areas of Critical Environmental Concern (ACECs) Regulations	310 CMR 12.00	Applicable, if ACEC is identified	An ACEC is of regional, state, or national importance or contains significant ecological systems with critical interrelationships among a number of components. An eligible area must contain features from four or more of the following groups: (1) fisheries, (2) coastal features, (3) estuarine wetlands, (4) inland wetlands, (5) inland surface waters, (6) water supply areas (e.g., aquifer recharge area); (7) natural hazard areas (e.g., floodplain); (8) agricultural areas; (9) historical/archeological resources; (10) habitat resources (e.g., for endangered wildlife); or (11) special use areas. After an area is designated as an ACEC, the aim is to preserve and restore these areas.

Appendix 6 - Attachment 1 - Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered Advisories, Criteria or Guidance - Chemical-Specific
Olin Chemical Superfund Site Feasibility Study
Wilmington, Massachusetts

Media	Requirement	Citation	Status	Requirement Synopsis
Federal Standards				
Groundwater	Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCLs)	42 USC § 300f *et seq.*; 40 CFR Part 141, Subparts B and G	Potentially Relevant and Appropriate	Establish MCLs for common organic and inorganic contaminants applicable to public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques.
Groundwater	SDWA National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)	42 USC § 300f *et seq.*; 40 CFR Part 141, Subpart F	Potentially Relevant and Appropriate for non-zero MCLGs only; MCLGs set as zero are To Be Considered	Establish MCLGs for several organic and inorganic contaminants in public drinking water supplies. MCLGs specify the maximum concentration at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable health based goals set equal to or lower than MCLs.
Groundwater	EPA, Office of Water, Drinking Water Health Advisories		Potentially To Be Considered	Health Advisories (HAs) are estimates of acceptable drinking water levels for chemical substances based on health effects information; a HA is not a legally enforceable federal standard, but serves as technical guidance to assist federal, state and local officials.
All	EPA Risk Reference Doses (RfDs)		Potentially To Be Considered	RfDs are considered to be the levels unlikely to cause significant adverse non-cancer health effects associated with a threshold mechanism of action in human exposure for a lifetime. Used in developing risk-based cleanup standards by computing human health hazard resulting from exposure to non-carcinogens at the Site.
All	Human Health Assessment Cancer Slope Factors (CSFs)		Potentially To Be Considered	CSFs are estimates of the upper-bound probability on the increased cancer risk from a lifetime exposure to contaminants. Used in developing risk-based cleanup standards by computing the incremental cancer risk from exposure to contaminants at the Site.

Media	Requirement	Citation	Status	Requirement Synopsis
All	Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F, March 2005	Potentially To Be Considered	Guidance values are to be used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.
All	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F, March 2005	Potentially To Be Considered	Guidance values are to be used to evaluate the potential carcinogenic hazard to children caused by exposure to contaminants.
Surface Water Quality	Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1314(a); 40 CFR Part 131	Potentially Relevant and Appropriate	NRWQC are established by EPA for the protection of aquatic life and human health in surface water for approximately 150 pollutants.
Soil	Regional Screening Levels for Chemical Contaminants at Superfund Sites		Potentially To Be Considered	Regional Screening Levels (RSLs) are risk-based tools for screening contaminants at Superfund sites. RSLs are not intended to be cleanup standards.
Soil	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites	OSWER 9355.4-24 (2002)	Potentially To Be Considered	EPA guidance for evaluating soil contamination. Used to develop risk-based cleanup standards, including based on the leaching of soil contaminants to groundwater.
Soil	Soil Screening Guidance: Technical Background Document	EPA/540/R95/128 (1996)	Potentially To Be Considered	EPA guidance for evaluating soil contamination. Used to develop risk-based cleanup standards.
Soil/Sediment	Guidance on Remedial Actions for Superfund Sites with PCB Contamination	EPA-540-G-90-007 (August 1990)	Potentially To Be Considered	EPA guidance for evaluating risks posed by PCBs at Superfund sites. Used to develop risk-based cleanup standards.
Wetland Soil/Sediment	Ontario Ministry of Environment and Energy (OMEE) Severe Effect Levels (SELs) for Freshwater Sediments	(Persaud *et al.*, 1993)	Potentially To Be Considered	The SEL value is the concentration at which the majority of the sediment-dwelling organisms are affected. Used to develop risk-based cleanup standards.

Media	Requirement	Citation	Status	Requirement Synopsis
Wetland Soil/Sediment	Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Probable Effects Concentrations (PECs)	(MacDonald *et al.*, 2000)	Potentially To Be Considered	The PEC value is the concentration above which the adverse effects on sediment-dwelling organisms are likely to occur. Used to develop risk-based cleanup standards.
State Standards				
Groundwater	Massachusetts Drinking Water Regulations	310 CMR 22.00	Potentially Relevant and Appropriate	Establishes maximum contaminant levels that apply to public drinking water supplies. Massachusetts MCLs and MCLGs are specified for numerous contaminants, including inorganic and organic chemicals. For the most part, the numerical criteria are identical to Federal SDWA MCLs and MCLGs, although there are several additional chemicals that have criteria.
Groundwater	Massachusetts Contingency Plan (MCP)	310 CMR 40.0000, Method 1 GW-1 Standards	Potentially To Be Considered	The MCP Method 1 groundwater standards assume exposure to concentrations of hazardous materials in groundwater under current or foreseeable future conditions. These standards contain a list of numerical, risk-based limitations on particular contaminants in groundwater based on the groundwater classification.
Groundwater	Massachusetts Drinking Water Guidelines		Potentially To Be Considered	MassDEP's Office of Research and Standards issues guidance for chemicals other than those with Massachusetts MCLs in drinking water.

Appendix 6 - Attachment 1 - Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered Advisories, Criteria or Guidance - Action-Specific
Olin Chemical Superfund Site Feasibility Study
Wilmington, Massachusetts

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
Federal Standards				
Hazardous Waste	Resource Conservation and Recovery Act (RCRA) Subtitle C; Hazardous Waste Identification; Generator and Handler Requirements; Tracking Requirements; Storage, Treatment and Disposal Requirements; Groundwater Monitoring Requirements; Closure and Post Closure Requirements; Land Disposal Restriction Requirements	42 USC § 6901 *et seq*.; 40 CFR Parts 260-262, 264/(including Subparts B, C, D, E, F, G, I, J, K, L, M, N, W, X) and 268	Potentially Applicable or Relevant and Appropriate	Federal standards used to identify, manage and dispose of hazardous waste. Massachusetts has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the Commonwealth.
Hazardous Waste – Air Emissions	RCRA, Air Emission Standards for Process Vents	40 CFR Part 264, Subpart AA	Potentially Applicable or Relevant and Appropriate	RCRA emissions standards not delegated to the State. Standards for process vents for systems that manage hazardous wastes that have organic concentrations of at least 10 ppmw.
Hazardous Waste – Air Emissions	RCRA, Air Emission Standards for Equipment Leaks	40 CFR Part 264, Subpart BB	Potentially Applicable or Relevant and Appropriate	RCRA emissions standards not delegated to the State. Standards for air equipment leaks for systems that manage hazardous wastes with organic concentrations of at least 10% by weight.
Hazardous Waste – Air Emissions	RCRA, Air Emission Standards for Tanks, Surface Impoundments, Containers	40 CFR Part 264, Subpart CC	Potentially Applicable or Relevant and Appropriate	RCRA emissions standards not delegated to the State. Standards for certain tanks, surface impoundments, containers that treat, store, or dispose of hazardous wastes.

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
Management of PCB-Contaminated Soil	Toxic Substances Control Act (TSCA); PCB Remediation Waste	15 USC § 2601 *et seq*., 40 CFR § 761.61(c)	Potentially Applicable	This section of the TSCA regulations provides risk-based cleanup and disposal options for polychlorinated biphenyl (PCB) remediation waste based on the risks posed by the concentrations at which the PCBs are found. Written approval for the proposed risk-based cleanup must be obtained from the Director, Office of Site Remediation and Restoration, USEPA Region 1.
Discharges to Surface Water; Storm Water Controls	Clean Water Act National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Potentially Applicable	The NPDES permit program specifies the permissible concentration or level of contaminants in the discharge from any point source to waters of the United States. Also, includes storm water standards for activities disturbing more than one acre.
Discharges to Surface Waters	Clean Water Act; Toxic Pollutant Effluent Standards	40 CFR Part 129	Potentially Applicable	Regulates surface water discharges of specific toxic pollutants, specifically certain pesticides and PCBs.
Discharge to a Publicly Owned Treatment Works (POTW)	General Pretreatment Regulations for Existing and New Sources of Pollution	40 CFR Part 403	Potentially Applicable	Establishes responsibilities of federal, state, and local government, industry and the public to implement National Pretreatment Standards to control pollutants which pass through or interfere with treatment processes in POTWs or which may contaminate sewage sludge.
Surface Water Quality/Sediment Monitoring	Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1314(a); 40 CFR Part 131	Potentially Relevant and Appropriate	NRWQC are established by EPA for the protection of aquatic life and human health in surface water for approximately 150 pollutants.
Underground Injection	SDWA Underground Injection Control (UIC) Program	40 CFR Parts 144, 147, 147 (Subpart W)	Potentially Applicable or Relevant and Appropriate	These regulations outline minimum program and performance standards for the UIC program. Technical criteria and standards for siting, operating, closure, and post-closure are set forth in Part 146.
Chemical, Physical, and Biological Treatment	RCRA Interim Status Treatment, Storage and Disposal Facility Standards. Chemical, Physical and Biological Treatment.	40 CFR Part 265, Subpart Q	Potentially Applicable or Relevant and Appropriate	Standards for operating chemical, physical and biological treatment systems for hazardous waste, including the proper handling of reagents, system maintenance, and closure procedures.

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
Air emissions	Clean Air Act (CAA), Hazardous Air Pollutants; National Emission Standards for Hazardous Air Pollutants (NESHAPs)	42 USC § 112(b)(1); 40 CFR Part 61	Potentially Applicable	These regulations establish emissions standards for 189 hazardous air pollutants.
Sediment Remediation	Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	EPA-540-R-05-012; OSWER 9355.0-85 (December 2005)	Potentially To Be Considered	Guidance for making remedy decisions for contaminated sediment sites. Some of the relevant sections of the guidance address Remedial Investigations (Ch. 2), FS Considerations (Ch. 3), Monitored Natural Recovery (Ch. 4), *In-Situ* Capping (Ch. 5), and Dredging and Excavation (Ch. 6).
Investigation-Derived Wastes (IDW)	Guide to Management of Investigation-Derived Wastes	OSWER 9345.3-03FS (January 1992)	Potentially To Be Considered	Guidance on the management of IDW in a manner that ensures protection of human health and the environment.
Groundwater Remediation	Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration	OSWER 9283.1-33 (June 26, 2009)	Potentially To Be Considered	Guidance on developing groundwater remedies at CERCLA sites.
Monitored Natural Attenuation (MNA)	Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER 9200.4-17P (April 21, 1999)	Potentially To Be Considered	Guidance regarding the use of monitored natural attenuation for the cleanup of contaminated soil and groundwater.
Vapor Intrusion	OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air.	OSWER 9200.2-154 (June 2015)	Potentially To Be Considered	EPA guidance for addressing vapor intrusion issues at CERCLA sites.

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
State Standards				
Hazardous Waste Identification	Massachusetts Hazardous Waste Rules for Identification and Listing of Hazardous Wastes	310 CMR 30.100	Potentially Applicable	Massachusetts is delegated to administer RCRA through its state regulations. These regulations establish requirements for determining whether wastes are either listed or characteristic hazardous waste.
Hazardous Waste – Generator Standard	Massachusetts Hazardous Waste Rules – Requirements for Generators	310 CMR 30.300	Potentially Applicable	These regulations contain requirements for generators of hazardous waste. The regulations apply to generators of sampling waste and also apply to the accumulation of waste prior to off-site disposal.
Hazardous Waste – Management Standards	Massachusetts Hazardous Waste Rules – Management Standards for All Hazardous Waste Facilities	310 CMR 30.500	Potentially Applicable or Relevant and Appropriate	General facility requirements for waste analysis, security measures, inspections, and training requirements. Section 30.580 addresses closure and, Section 30.590 addresses post-closure of hazardous waste facilities.
Hazardous Waste – Technical Facility Standards	Massachusetts Hazardous Waste Rules – Technical Standards for All Hazardous Waste Facilities	310 CMR 30.600	Potentially Applicable or Relevant and Appropriate	Standards for the design, performance, operation, maintenance, and monitoring of hazardous waste facilities, including miscellaneous units.
Hazardous Waste – Wastewater Treatment	Massachusetts Hazardous Waste Rules – Special Requirements for Wastewater Treatment Units	310 CMR 30.605	Potentially Applicable or Relevant and Appropriate	Standards for wastewater treatment units for the treatment of hazardous waste.
Hazardous Waste – Surface Impoundments	Massachusetts Hazardous Waste Rules – Surface Impoundments	310 CMR 30.610	Potentially Applicable or Relevant and Appropriate	310 CMR 30.611 through 30.618 prescribe requirements for storage, treatment and disposal of hazardous waste in surface impoundments. Provides specifications for *inter alia* design and operations, testing, monitoring and inspection, and closure and post-closure care.
Hazardous Waste – Landfills	Massachusetts Hazardous Waste Rules – Landfills	310 CMR 30.620	Potentially Applicable or Relevant and Appropriate	310 CMR 30.621 through 30.633 prescribe requirements for disposal of hazardous waste in landfills. Provides specifications for *inter alia* design and operations, monitoring and inspection, and closure and post-closure care.

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
Hazardous Waste – Landfill Closure	Massachusetts Hazardous Waste Rules – Landfill Closure and Post Closure Care	310 CMR 30.633	Potentially Applicable or Relevant and Appropriate	Standards for capping hazardous waste landfills: (1) provide long-term minimization of migration of liquids through the waste; (2) function with minimum maintenance; (3) promote drainage and minimize erosion or abrasion of the cover; (4) accommodate settling and subsidence so that the cover's integrity is maintained; and (5) have a permeability less than or equal to the permeability of the bottom liner system. Provides requirements for post-closure care.
Hazardous Waste – Waste Piles	Massachusetts Hazardous Waste Rules – Waste Piles	310 CMR 30.640	Potentially Applicable or Relevant and Appropriate	310 CMR 30.641 through 30.649 prescribe requirements for storage and treatment of hazardous waste in waste piles. Provides specifications for *inter alia* design and operations, monitoring and inspection, and closure and post-closure care.
Hazardous Waste – Land Treatment Units	Massachusetts Hazardous Waste Rules – Land Treatment Units	310 CMR 30.650	Potentially Applicable or Relevant and Appropriate	310 CMR 30.651 through 30.659 prescribe requirements for treatment and disposal of hazardous waste in land treatment units. Provides specifications for *inter alia* design and operations, monitoring, and closure and post-closure care.
Hazardous Waste – Groundwater	Massachusetts Hazardous Waste Rules – Groundwater Protection	310 CMR 30.660	Potentially Applicable or Relevant and Appropriate	310 CMR 30.661 through 30.673 prescribe requirements for regulated units that receive hazardous waste, except for certain waste piles, to protect groundwater.
Hazardous Waste – Containers	Massachusetts Hazardous Waste Rules – Use and Management of Containers	310 CMR 30.680	Potentially Applicable	310 CMR 30.681 through 30.689 prescribe requirements for the use of containers, such as drums, to store hazardous waste. Provides specifications for *inter alia* labelling and marking, management of containers, inspections, and closure.
Hazardous Waste - Tanks	Massachusetts Hazardous Waste Rules –Storage and Treatment in Tanks	310 CMR 30.690	Potentially Applicable	310 CMR 30.691 through 30.699 prescribe requirements for the use of tanks to store and treat hazardous waste. Provides specifications for *inter alia* design and installation, containment and detection of leaks, general operating requirements, inspections, and closure and post-closure care.
Discharges to Surface Waters	Massachusetts Clean Water Act; Surface Water Discharge Permit Regulations	MGL c. 21, §§ 26-53; 314 CMR 3.00	Potentially Applicable	These regulations provide that discharges to waters of the Commonwealth shall not result in exceedances of Massachusetts Surface Water Quality Standards (MSWQS) (314 CMR 4.00).

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
Surface Water Quality Monitoring	Massachusetts Clean Water Act; Massachusetts Surface Water Quality Standards (MSWQS)	MGL c 21, §§ 26-53; 314 CMR 4.00	Potentially Applicable or Relevant and Appropriate	These standards designate the most sensitive uses for which the various waters of the Commonwealth shall be enhanced, maintained, or protected. Minimum water quality criteria required to sustain the designated uses are established.
Hazardous Waste – Facility Discharge Standards	Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities	MGL c. 21, §§ 26-53; 314 CMR 8.00	Potentially Relevant and Appropriate	This regulation establishes additional requirements that must be satisfied for a RCRA facility (a wastewater treatment works which manages hazardous waste) that has a wastewater discharge permit.
Discharges from Treatment Works or to a Publicly Owned Treatment Works (POTW)	MassDEP Operation, Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Dischargers	314 CMR 12.00	Potentially Applicable	Standards for the operation of wastewater treatment works as well as pretreatment requirements for sources to a POTW.
Underground Injection	Massachusetts Underground Injection Control Regulations	310 CMR 27.00	Potentially Applicable	These regulations protect underground sources of drinking water by regulating the underground injection of hazardous wastes, fluids used for extraction of minerals, oil, and energy, and any other fluids having potential to contaminate groundwater.
Groundwater	Massachusetts Ground Water Discharge Permit Program	314 CMR 5.00	Potentially Applicable	These regulations control the discharges of pollutants to groundwater to ensure that groundwaters are protected for their actual and potential use as a source of potable water, that surface waters are protected for their existing and designated uses, and that Massachusetts Surface Water Quality Standards (314 CMR 4.00) are attained and maintained. These regulations establish requirements for the discharge to groundwater, including effluent limits for the discharge of pollutants.
Groundwater, Surface Water and Gas Monitoring	Massachusetts Solid Waste Management Regulations –Ground Water, Surface Water and Gas Monitoring Systems	310 CMR 19.118	Potentially Relevant and Appropriate	These regulations establish, for all solid waste disposed by placement into or onto land, requirements for groundwater, surface water, and landfill gas monitoring systems capable of detecting and quantifying the release of contaminants into the ground, groundwater, surface water, and the air.

Action/Trigger	Requirement	Citation	Status	Requirement Synopsis
Air Emissions	Massachusetts Ambient Air Quality Standards	310 CMR 6.00	Potentially Applicable	These regulations establish primary and secondary standards for emissions of sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead.
Air Emissions	Massachusetts Air Pollution Control Regulations	310 CMR 7.00	Potentially Applicable	These regulations set emission limits necessary to attain ambient air quality standards, including standards for visible emissions (7.06); dust, odor, construction and demolition (7.09); noise (7.10); and volatile organic compounds (7.18).
DAPL/NAPL Cleanup	Massachusetts Contingency Plan, NAPL	310 CMR 40.1003(7)	Potentially Relevant and Appropriate	Establish standards for response actions taken at hazardous material sites to adequately contain or remove NAPL.
Institutional Controls	Massachusetts Contingency Plan, Implementation of Activity and Use Limitations	310 CMR 40.1070(4)	Potentially Applicable	Establish standards for the use of Notice of Activity and Use Limitations, a form of institutional controls, at CERCLA sites in Massachusetts.
Monitoring Wells	Massachusetts Standard References for Monitoring Wells	WSC–310-91	Potentially To Be Considered	Guidance on locating, drilling, installing, sampling and decommissioning monitoring wells.
Sediment/Erosion Control; Stormwater Management	Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas	Prepared for Massachusetts Executive Office of Environmental Affairs (original print March 1997; reprint May 2003)	Potentially To Be Considered	Guidance on preventing erosion and sedimentation.

Appendix 6 - Attachment 2 - Evaluation of Compliance with Location-Specific ARARs and TBCs for All Media
Source Control Feasibility Study
Olin Chemical Superfund Site, Wilmington, MA
Alternative SS-X: Excavation and Off-Site Disposal of BREA EA5 Surface Soil and Lower South Ditch Sediment
Alternative GW-X: Groundwater/DAPL Extraction and Off-Site Disposal [Note: these two alternatives (SS-X and GW-X) are provided as examples; all alternatives developed in the FS shall have ARAR analyses]

[**Overall comment** – These tables are provided as examples only to show the level of ARAR analysis required for each remedial alternative that is evaluated in the FS reports. These ARARs tables, evaluating alternatives' compliance with ARARs, are to be read in conjunction with the potential ARARs tables (Appendix 6 – Attachment 1), as the Requirement Synopsis descriptions in that table are not repeated here. The alternatives/technologies included in these example tables were selected because they were analyzed in the March 2018 Draft OU1 and OU2 FS Report or the Draft OU3 FS Report, and may be included in the Source Control FS Report. The structure/format of the tables may need to be adjusted depending on how Olin chooses to combine the technologies/components and address the various media. The ARARs tables shall analyze each ARAR or TBC that potentially applies to each component of each alternative.]

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Federal Standards					
Floodplain Management and Protection of and Wetlands	44 CFR Part 9 (implementing EO 11988 and 11990)	SS-X - Applicable GW-3, 4 & X – Applicable, if alternatives alter wetlands or floodplains	If there is no practicable alternative method to work in federal jurisdictional wetlands, then all practicable measures will be taken to minimize and mitigate any adverse impacts. Erosion and sedimentation control measures will be adopted during excavation, material management, and restoration activities to protect federal jurisdictional wetlands. Standards for excavating and managing contaminated soil, sediment, groundwater/DAPL, etc. within the regulated 500-year floodplain will be attained. After completion of the work, there will be no significant net loss of flood storage capacity and no significant net increase in flood stage or velocities. Floodplain habitat will be restored, to the extent practicable. Public comment will be solicited as part of the Proposed Plan concerning any proposed alteration to wetlands and floodplain.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative requires alteration of wetlands and floodplains and will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration. Federal jurisdictional wetlands altered by wetland soil/sediment excavation/management and excavation dewatering will be restored in place. The wetland will be backfilled to its original grade. All remedial work within the regulated 500-year floodplain will result in no significant net loss of flood storage capacity and no significant net increase in flood stage or velocities. Floodplain habitat will be restored, to the extent practicable.	GW-1 – No action, therefore not applicable GW-2, … – GW-3, 4, & X – If these alternatives alter wetlands or floodplains, they will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration. **[Note: this an example of grouping alternatives together to discuss specifically how the alternatives will comply with the ARARs; see also the status column]**

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
RCRA Floodplain Restrictions for Hazardous Waste Facilities	42 USC § 6901 *et seq.*; 40 CFR § 264.18(b)	SS-X – Applicable, if alternative involves management of hazardous waste in floodplain GW-X – Applicable, if alternative involves management of hazardous waste in floodplain	To the extent any hazardous waste is generated during the remedial activities, the waste will be managed so that it will not impact floodplain resources.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – If this alternative generates hazardous waste from the soil and sediment excavation or excavation dewatering activities, it will comply with ARAR by managing such hazardous waste so that it will not impact floodplain resources.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If this alternative generates hazardous waste from the groundwater/DAPL extraction activities, it will comply with ARAR by managing such hazardous waste so that it will not impact floodplain resources.
RCRA Floodplain Restrictions for Solid Waste Disposal Facilities and Practices	40 CFR § 257.3-1	SS-X – Applicable GW-X – Applicable	Any solid waste generated from remedial activities involving excavation activities will be managed so that it will not impact floodplain resources.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any solid waste generated from the soil and sediment excavation or excavation dewatering activities will be managed so that it will not impact floodplain resources.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any solid waste generated from the groundwater/DAPL extraction activities will be managed so that it will not impact floodplain resources.
Clean Water Act § 404, and regulations	33 USC § 1344; 40 CFR Parts 230, 231 and 33 CFR Parts 320-323	SS-X – Applicable GW-X – Applicable, if there is a discharge of fill material into water bodies or wetlands	The remedial alternatives' effects on surface waters and wetlands will be evaluated and avoided, and/or minimized. Compensatory wetlands mitigation will need to be performed as necessary to comply with this ARAR. The selected alternative will need to be determined to be the least environmentally damaging practicable alternative that meets the remedial action objectives. Any required removal of soil/sediment from wetland or surface water areas will be designated for eventual restoration.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative requires alteration of wetlands and will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If there is a discharge of fill material into water bodies or wetlands, this alternative will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration.
Wetlands - U.S. Army Corps of Engineers, New England District Compensatory Mitigation Guidance	U.S. Army Corps of Engineers, New England District Compensatory Mitigation Guidance (09-07-2016)	SS-X – To Be Considered GW-X – To Be Considered	Activities affecting federal jurisdictional wetlands will be conducted in accordance with these guidance standards for mitigation and restoration.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative requires alteration of wetlands and the mitigation and restoration activities taken will be based on these guidance standards.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If this alternative requires alteration of wetlands, the mitigation and restoration activities taken will be based on these guidance standards.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Fish and Wildlife Coordination Act	16 USC §§ 662-663; 40 CFR Part 6	SS-X – Applicable GW-X – Applicable, if wildlife habitat is altered	To the extent necessary, actions will be taken to prevent, mitigate, or compensate for project related impacts to habitat and wildlife. The USFWS, acting as a review agency for the EPA, will be kept informed of proposed remedial activities.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative requires alteration of wildlife habitat and will comply with ARAR through appropriate consultation and implementation of measures to prevent, mitigate, or compensate for project related impacts to habitat and wildlife.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If this alternative alters wildlife habitat, it will comply with ARAR through appropriate consultation and implementation of measures to prevent, mitigate, or compensate for project related impacts to habitat and wildlife.
Endangered Species Act	50 CFR §§ 17.11- 17.12; 50 CFR Part 402	SS-X – Applicable, if such species are encountered GW-X – Applicable, if such species are encountered	Protection of endangered species and their habitat will be considered during development and design of remedial alternatives.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – No endangered or threatened species have been identified at the Site to date. If endangered or threatened species in the site area are identified, remedial activities would avoid actions that adversely affect endangered or threatened species or their habitats.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – No endangered or threatened species have been identified at the Site to date. If endangered or threatened species in the site area are identified, remedial activities would avoid actions that adversely affect endangered or threatened species or their habitats.
National Historic Preservation Act	16 USC §§ 469 *et seq.*; 36 CFR Part 65	SS-X – Applicable, if protected resource areas are present GW-X – Applicable, if protected resource areas are present	Any undisturbed areas altered by the remedial activities will be assessed to ensure no protected resource areas are present. If present there will be consultation with federal and state preservation officials to address measures to avoid, minimize and/or mitigate any impacts to protected resource areas.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Under this alternative, if protected resource areas are identified in the site area, measures to avoid, minimize and/or mitigate any impacts to protected resource areas will be implemented in consultation with federal and state historic preservation officials.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Under this alternative, if protected resource areas are identified in the site area, measures to avoid, minimize and/or mitigate any impacts to protected resource areas will be implemented in consultation with federal and state historic preservation officials.
Migratory Bird Treaty Act	16 USC § 703 *et seq.*	SS-X – Applicable, if protected areas are present GW-X – Applicable, if protected areas are present	Remedial activities will be evaluated to protect migratory birds, their nests and eggs.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Under this alternative, if migratory bird protected areas are identified in the site area, measures to avoid, minimize and/or mitigate any impacts to protected resource areas will be implemented in consultation with appropriate USFWS officials.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Under this alternative, if migratory bird protected areas are identified in the site area, measures to avoid, minimize and/or mitigate any impacts to protected resource areas will be implemented in consultation with appropriate USFWS officials.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
State Standards					
Massachusetts Wetlands Protection Act and Regulations	MGL c. 131, § 40; 310 CMR 10.00	SS-X – Applicable GW-X – Applicable, if there is impact to state regulated wetland resource areas	Any remedial activity conducted within a state regulated wetland resource area will comply with the substantive requirements of these regulations. Mitigation of impacts on state wetland resource areas will be addressed.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative requires alteration of state regulated wetland resource areas and will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration. State wetland resource areas altered by wetland soil/sediment excavation/management and excavation dewatering will be restored in place. State wetland resource areas will be backfilled to their original grade. All remedial work within the regulated 100-year floodplain will result in no significant net loss of flood storage capacity and no significant net increase in flood stage or velocities. Floodplain habitat will be restored, to the extent practicable.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Under this alternative, groundwater/DAPL extraction and excavated material management may impact state regulated wetland resource areas. If this alternative alters state regulated wetland resource areas, it will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration.
Massachusetts Hazardous Waste Regulations, Location Standards for Land Subject to Flooding	310 CMR 30.701	SS-X – Applicable, if alternative involves management of hazardous waste in floodplain GW-X – Applicable, if alternative involves management of hazardous waste in floodplain	To the extent any hazardous waste is generated during the remedial activities, the wastes will be managed so that it will not impact floodplain resources.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – If this alternative generates hazardous waste from the soil and sediment excavation or excavation dewatering activities, it will comply with ARAR by managing such hazardous waste so that it will not impact floodplain resources.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If this alternative generates hazardous waste from the groundwater/DAPL extraction activities, it will comply with ARAR by managing such hazardous waste so that it will not impact floodplain resources.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Massachusetts Clean Water Act; Water Quality Certification for Discharge of Dredged or Fill Material	MGL c. 21, §§ 26-53; 314 CMR 9.00	SS-X – Applicable GW-X – Applicable, if there is a discharge of fill material into water bodies or wetlands	The remedial alternatives' effects on the aquatic ecosystem will be evaluated and avoided, and/or minimized. Compensatory mitigation will need to be performed as necessary to comply with this ARAR. The selected alternative will need to be determined to be the least environmentally damaging practicable alternative that meets the remedial action objectives. Any required removal of soil/sediment from wetland or surface water areas will be designated for eventual restoration. Excavation and filling activities to be performed impacting the aquatic ecosystem will be in accordance with the substantive requirements of these regulations.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative requires alteration of wetlands and will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If this alternative requires alteration of wetlands, installation and maintenance of monitoring and extraction wells, access ways, and treatment systems to address DAPL and contaminated groundwater will comply with ARAR through appropriate avoidance, minimization, mitigation and restoration.
Massachusetts Endangered Species Regulations	321 CMR 10.00	SS-X – Applicable, if such species are encountered GW-X – Applicable, if such species are encountered	Protection of state listed endangered species and their habitat will be considered during development and design of remedial alternatives.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – If state-listed endangered or threatened species in the site area are identified, remedial activities would avoid actions that would adversely affect endangered or threatened species or their habitats.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If state-listed endangered or threatened species in the site area are identified, remedial activities would avoid actions that would adversely affect endangered or threatened species or their habitats.
Protection of Properties Included in the State Register of Historic Places	MGL c. 9, §§ 26-27C; 950 CMR 71.00	SS-X – Applicable, if protected resource areas are present GW-X – Applicable, if protected resource areas are present	Projects must eliminate, limit, or mitigate adverse effects to properties listed in the State Register of Historic Places (historic and archaeological properties). Establishes coordination with the National Historic Preservation Act.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Under this alternative, if protected resource areas are identified in the site area, measures to avoid, minimize and/or mitigate any impacts to protected resource areas will be implemented in consultation with federal and state historic preservation officials.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Under this alternative, if protected resource areas are identified in the site area, measures to avoid, minimize and/or mitigate any impacts to protected resource areas will be implemented in consultation with federal and state historic preservation officials.
Area of Critical Environmental Concern	310 CMR 12.00	SS-X – Applicable, if ACEC is present GW-X – Applicable, if ACEC is present	Should ACEC be identified, activities must be controlled to minimize impacts to affected species.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – If ACEC is identified in the site area, activities will be controlled to minimize impacts to affected species.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – If ACEC is identified in the site area, activities will be controlled to minimize impacts to affected species.

Appendix 6 - Attachment 2 - Evaluation of Compliance with Chemical-Specific ARARs and TBCs for Soil and Sediment
Source Control Feasibility Study
Olin Chemical Superfund Site, Wilmington, MA
Alternative SS-X: Excavation and Off-Site Disposal of BREA EA5 Surface Soil and Lower South Ditch Sediment

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives
Federal Standards				
Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCLs)	42 USC § 300f *et seq.* 40 CFR Part 141, Subparts B and G	Relevant and Appropriate	MCLs are relevant and appropriate because the aquifer at and in the vicinity of the Site is a current or potential drinking water source area. MCLs were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, … - SS-X – This alternative will comply with ARAR through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)	42 USC § 300f *et seq.* 40 CFR Part 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; MCLGs set as zero are To Be Considered	MCLGs are relevant and appropriate because the aquifer at and in the vicinity of the Site is a current or potential drinking water source area. MCLGs were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, … - SS-X – This alternative will comply with ARAR through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
EPA, Drinking Water Health Advisories (HAs)		To Be Considered	HAs were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
EPA Risk Reference Doses (RfDs)		To Be Considered	RfDs were used to assess health risks due to exposure to non-carcinogenic chemicals in soil and to develop soil PRGs. In addition, RfDs were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, … - SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated non-carcinogenic-risk based standards developed using this guidance through removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives
EPA Carcinogenic Assessment Group, Cancer Slope Factors (CSFs)		To Be Considered	CSFs were used to assess health risks due to exposure to carcinogenic chemicals in soil and to develop soil PRGs. In addition, CSFs were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, ... - SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated carcinogenic-risk based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F, March 2005	To Be Considered	These guidelines were used to assess health risks due to exposure to carcinogenic chemicals in soil and to develop soil PRGs. In addition, these guidelines were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, ... – SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated carcinogenic-risk based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F, March 2005	To Be Considered	This guidance was used to assess health risks due to exposure to carcinogenic chemicals in soil and to develop soil PRGs. In addition, this guidance was used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, ... – SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated carcinogenic-risk based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
Regional Screening Levels for Chemical Contaminants at Superfund Sites		To Be Considered	These screening levels were used to assess health risks due to exposure to chemicals in soil and to develop soil PRGs. In addition, these screening levels were used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, ... - SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated risk-based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives
Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites	OSWER 9355.4-24 (2002)	To Be Considered	This guidance was used to assess health risks due to exposure to chemicals in soil, including based on the leaching of soil contaminants to groundwater, and to develop soil PRGs.	SS-1 – No action, therefore not applicable SS-2, ... - SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated risk-based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
Soil Screening Guidance: Technical Background Document	EPA/540/R95/ 128 (1996)	To Be Considered	This guidance was used to assess health risks due to exposure to chemicals in soil and to develop soil PRGs. In addition, this guidance was used to derive soil PRGs for the leaching of contaminants from soil as a transport mechanism in groundwater.	SS-1 – No action, therefore not applicable SS-2, ... - SS-X – This alternative would prevent exposure to soil contaminants that exceed calculated risk-based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. In addition, this alternative will comply with this TBC through excavation and off-site disposal of all soil exceeding PRGs established to address the leaching of contaminants from soil as a transport mechanism in groundwater.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	EPA-540-G-90-007 (August 1990)	To Be Considered	This guidance was used to assess health risks due to exposure to PCBs in soil and to develop soil PRGs.	SS-1 – No action, therefore not applicable [**Note – to serve as an example, alternative SS-2 was assumed to address PCB-contaminated soil**] SS-2, ... - This alternative would prevent exposure to PCBs in soil that exceed calculated risk-based standards developed using this guidance through the removal of all soil that poses a commercial/industrial/recreational risk and ICs to prevent residential exposure. SS-X – Not applicable because remedial alternative does not address PCBs.
Ontario Ministry of Environment and Energy (OMEE) Severe Effect Levels (SELs) for Freshwater Sediments	(Persaud *et al.*, 1993)	To Be Considered	SELs were used to assess ecological risks due to exposure to chemicals in sediment and to develop sediment PRGs.	SS-1 – No action, therefore not applicable SS-2, ... - SS-X – This alternative would prevent ecological contact with wetland soils/sediment that exceed calculated risk-based standards developed using this guidance through the removal of all sediment that poses an ecological risk.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives
Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Probable Effects Concentrations (PECs)	(MacDonald et al., 2000)	To Be Considered	PECs were used to assess ecological risks due to exposure to chemicals in sediment and to develop sediment PRGs.	SS-1 – No action, therefore not applicable SS-2, ... - SS-X – This alternative would prevent ecological contact with wetland soils/sediment that exceed calculated risk-based standards developed using this guidance through the removal of all sediment that poses an ecological risk

Appendix 6 - Attachment 2 - Evaluation of Compliance with Chemical-Specific ARARs and TBCs for Groundwater
Source Control Feasibility Study
Olin Chemical Superfund Site, Wilmington, MA
Alternative GW-X: Groundwater/DAPL Extraction and Off-Site Disposal

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Groundwater Alternatives
Federal Standards				
Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCLs)	42 USC § 300f *et seq.* 40 CFR Part 141, Subparts B and G	Relevant and Appropriate	MCLs are relevant and appropriate because the aquifer at and in the vicinity of the Site is a current or potential drinking water source area. MCLs were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with ARAR through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.
Safe Drinking Water Act (SDWA) National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)	42 USC § 300f *et seq.* 40 CFR Part 141, Subpart F	Relevant and Appropriate for non-zero MCLGs only; MCLGs set as zero are To Be Considered	MCLGs are relevant and appropriate because the aquifer at and in the vicinity of the Site is a current or potential drinking water source area. MCLGs were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with ARAR through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.
EPA, Drinking Water Health Advisories (HAs)		To Be Considered	HAs were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.
EPA Risk Reference Doses (RfDs)		To Be Considered	RfDs were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs
EPA Carcinogenic Assessment Group, Cancer Slope Factors (CSFs)		To Be Considered	CSFs were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.
Guidelines for Carcinogenic Risk Assessment	EPA/630/P-03/001F, March 2005	To Be Considered	These guidelines were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.

Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Groundwater Alternatives
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F, March 2005	To Be Considered	This guidance was used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all DAPL exceeding groundwater/DAPL PRGs.
State Standards				
Massachusetts Drinking Water Regulations	310 CMR 22.00	Relevant and Appropriate	Massachusetts MCLs and MCLGs are relevant and appropriate because the aquifer at and in the vicinity of the Site is a current or potential drinking water source area. Massachusetts MCLs and MCLGs were used to derive groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with ARAR through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.
Massachusetts Contingency Plan (MCP)	310 CMR 40.0000, Method 1 GW-1 Standards	To Be Considered	These standards were considered during development of groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.
Massachusetts Drinking Water Guidelines		To Be Considered	These guidelines were considered during development of groundwater/DAPL PRGs.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This alternative will comply with this TBC through extraction of and off-site disposal of all groundwater/DAPL exceeding groundwater/DAPL PRGs.

Appendix 6 - Attachment 2 - Evaluation of Compliance with Action-Specific ARARs and TBCs for All Media
Source Control Feasibility Study
Olin Chemical Superfund Site, Wilmington, MA
Alternative SS-X: Excavation and Off-Site Disposal of BREA EA5 Surface Soil and Lower South Ditch Sediment
Alternative GW-X: Groundwater/DAPL Extraction and Off-Site Disposal

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Federal Standards						
Use of a treatment, storage or disposal facility for hazardous waste	Resource Conservation and Recovery Act (RCRA) Subtitle C; Hazardous Waste Identification; Generator and Handler Requirements; Tracking Requirements; Storage, Treatment and Disposal Requirements; Groundwater Monitoring Requirements; Closure and Post Closure Requirements; Land Disposal Restriction Requirements	42 USC § 6901 *et seq.*; 40 CFR Parts 260-262, 264 (including Subparts B, C, D, E, F, G, I, J, K, L, M, N, W, X) and 268	Applicable; Relevant and Appropriate	Any wastes generated during remedial activities will be analyzed under these standards to determine whether they are listed or characteristic hazardous waste. Non-hazardous wastes will be disposed of appropriately. Any waste generated during remedial activities that is determined to be hazardous waste will be managed in accordance with these regulations. Alternatives generating hazardous waste or using treatment, storage or disposal facilities for hazardous waste will be implemented to comply with this ARAR.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – All soil and sediment determined to contain hazardous waste that is excavated will be managed as a hazardous waste. Releases from regulated hazardous waste facilities will be addressed under applicable closure/post-closure regulations. Under this alternative, any generation, treatment, or storage of hazardous waste will comply with ARAR through appropriate design, implementation, and operation. [**Note – capping alternatives are not currently addressed here; Olin will need to revise to address this issue**]	GW-1 – No action, therefore not applicable GW-2, … – GW-X – All groundwater/DAPL determined to be a listed or characteristic hazardous waste that is extracted will be managed as a hazardous waste and disposed of off-site at a licensed facility. Releases from regulated hazardous waste facilities will be addressed under applicable closure/post-closure regulations. Under this alternative, any generation, treatment, or storage of hazardous waste will comply with ARAR through appropriate design, implementation, and operation.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Hazardous Waste – Air Emissions	RCRA, Air Emission Standards for Process Vents, Equipment Leaks, Tanks, Surface Impoundments, and Containers	40 CFR Part 264, Subparts AA, BB, and CC **[Note – if it is clear now that one alternative will trigger one of these subparts, then these subparts should be broken out (like in the potential ARARs table, above)]**	Applicable, if hazardous waste with volatile organic concentrations of at least 10 parts per million by weight (ppmw) (Subpart AA), with organic concentrations of at least 10 % by weight (Subpart BB), will be treated, stored, or disposed of in tanks, surface impoundments, or containers, and thresholds are met (Subpart CC). Relevant and Appropriate, if less than thresholds	Any hazardous wastes generated during remedial activities that meet these rules' threshold requirements will be managed in accordance with these regulations.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – All soil and sediment determined to contain hazardous waste that is excavated will be managed as a hazardous waste. If the excavated soil/sediment is determined to contain VOCs in excess of the pertinent applicability thresholds, it will be managed in accordance with these regulations. Under this alternative, any treatment or storage of hazardous waste will comply with ARAR through appropriate design and operation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – All groundwater/DAPL determined to be a listed or characteristic hazardous waste that contains VOCs in excess of the pertinent applicability thresholds that is extracted and stored on-site will be managed in accordance with these regulations. Under this alternative, any treatment or storage of hazardous waste will comply with ARAR through appropriate design and operation.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Management of PCB-Contaminated Soil	Toxic Substances Control Act (TSCA); PCB Remediation Waste	15 USC § 2601 *et seq.*, 40 CFR § 761.61(c)	Applicable	The cleanup and disposal of PCB-contaminated soil will be performed in a manner to comply with TSCA. The Proposed Plan will include a proposed finding that the cleanup level selected meets these requirements for protectiveness. If an alternative is selected, the ROD would contain a finding by EPA that the alternative's PCB response will not pose an unreasonable risk of injury to health and the environment. Remedial measures will be based on *in-situ* PCB concentrations in soil.	SS-1 – No action, therefore not applicable SS-2, … – [**Here is an example for a soil alternative that addresses PCB-contaminated soil with excavation and off-site disposal**] – This alternative will comply with ARAR by excavating and disposing of off-site at a licensed facility all PCB-contaminated soil exceeding human health risk standards. Also, any water generated from the remedial activities that exceeds risk standards will be treated to meet protective PCB discharge limits. SS-X – This ARAR is not applicable to this alternative.	This ARAR is not applicable to these alternatives.
Discharges to Surface Water; Storm Water Controls	Clean Water Act National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125	Applicable, if surface water discharge occurs.	Alternatives that incorporate discharges to surface waters will need to have the discharges meet the substantive discharge standards (the Massachusetts Surface Water Discharge Permit Program [314 CMR 3.00] has similar requirements).	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any discharge to surface water from soil/sediment excavation/ management and excavation dewatering will be treated to meet these standards.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any discharge to surface water from groundwater/DAPL extraction will be treated to meet these standards.
Discharge to Surface Waters	Clean Water Act; Toxic Pollutant Effluent Standards	40 CFR Part 129	Applicable, if discharge to surface waters contains specific toxic pollutants addressed by this regulation.	Any water contaminated with the specific toxic pollutants addressed by this regulation generated during remedial activities will be treated to meet applicable toxic pollutant discharge standards if the water is to be discharged to surface waters.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any discharge to surface water from soil/sediment excavation/ management and excavation dewatering that contains the toxic pollutants addressed by this regulation will be treated to meet these standards.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any discharge to surface water from groundwater/DAPL extraction that contains the toxic pollutants addressed by this regulation will be treated to meet these standards.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Discharge to a Publicly Owned Treatment Works (POTW)	General Pretreatment Regulations for Existing and New Sources of Pollution	40 CFR Part 403	Applicable, if discharge to POTW	If remedial activities result in discharges to a POTW, the discharge will be monitored and treated, if necessary, to comply with pretreatment standards.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any water generated during soil/sediment excavation/ management and excavation dewatering will be treated, if necessary, to meet these standards, if the water is to be discharged to a POTW.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any water generated during groundwater/DAPL extraction will be treated, if necessary, to meet these standards, if the water is to be discharged to a POTW.
Surface Water Quality/Sediment Monitoring	Clean Water Act, National Recommended Water Quality Criteria (NRWQC)	33 USC § 1314; 40 CFR Part 131	Relevant and Appropriate, if surface water discharge occurs	Alternatives that incorporate discharges to surface waters will meet monitoring standards developed from these criteria.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any water generated during soil/sediment excavation/ management and excavation dewatering will be evaluated against these standards, if the water is to be discharged to a surface water.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any water generated during groundwater/DAPL extraction will be evaluated against these standards, if the water is to be discharged to a surface water.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Underground Injection	SDWA Underground Injection Control (UIC) Program	40 CFR Parts 144, 147, 147 (Subpart W)	Applicable, if underground injection is a component of the remedial alternative	The alternatives developed in this FS do not have underground injection as a component of a treatment train. If underground injection is considered as a potential treatment option, these regulations will be considered.	This ARAR is not applicable to these alternatives.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – No underground injection, therefore not applicable. [**Note: Use this language if there is possibility of underground injection – If any groundwater alternative involves underground injection, the alternative will comply with ARAR through appropriate design, implementation, monitoring and treatment, if necessary**.]
Chemical, Physical, and Biological Treatment	RCRA Interim Status Treatment, Storage and Disposal Facility Standards. Chemical, Physical and Biological Treatment.	40 CFR Part 265, Subpart Q	Relevant and Appropriate, if conducting *in situ* treatment of soils or groundwater	If *in situ* treatment of hazardous waste is utilized as part of alternative, the alternative will comply with ARAR through appropriate design and implementation.	SS-1 – No action, therefore not applicable SS-2, … – SS-3 – [**Here is an example for a soil alternative that includes *in situ* treatment of contaminated soil**] This alternative's use of *in situ* biological treatment will comply with ARAR through appropriate design, operation, maintenance and closure. SS-X – No *in situ* treatment, therefore not applicable.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – No *in situ* treatment, therefore not applicable.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Air emissions	Clean Air Act (CAA), Hazardous Air Pollutants; National Emission Standards for Hazardous Air Pollutants (NESHAPs)	42.U.S.C. § 112(b)(1); 40 CFR Part 61	Applicable	No air emissions from remedial activities will cause air quality standards to be exceeded. Dust standards will be complied with during remedial activities.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative will comply with ARAR during excavation and management of soil/sediment by ensuring that air quality standards and dust standards are not exceeded.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – This alternative will comply with ARAR during groundwater/DAPL extraction and treatment by ensuring that air quality standards are not exceeded.
Sediment Remediation	Contaminated Sediment Remediation Guidance for Hazardous Waste Sites	EPA-540-R-05-012; OSWER 9355.0-85 (December 2005)	To Be Considered	Guidance for making remedy decisions for contaminated sediment sites. Some of the relevant sections of the guidance address Remedial Investigations (Ch. 2), FS Considerations (Ch. 3), Monitored Natural Recovery (Ch. 4), *In-Situ* Capping (Ch. 5), and Dredging and Excavation (Ch. 6).	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative's proposed excavation and off-site disposal of contaminated sediment were developed in consideration of this guidance.	This TBC is not applicable to these alternatives.
Investigation-Derived Wastes (IDW)	Guide to Management of Investigation-Derived Wastes	OSWER 9345.3-03FS (January 1992)	To Be Considered	IDW generated during remedial activities and monitoring will comply with this guidance.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – IDW generated as part of this remedial alternative will be managed in compliance with this guidance.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – IDW generated as part of this remedial alternative will be managed in compliance with this guidance.
Groundwater Remediation	Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration	OSWER 9283.1-33 (June 26, 2009)	To Be Considered	Alternatives to address sources of contamination to overburden and bedrock aquifers were developed in consideration of this guidance.	This TBC is not applicable to these alternatives. **[Note: if an alternative is developed to address contaminated soil leaching contaminants to groundwater, then the statement above is incorrect]**	GW-1 – No action, therefore not applicable GW-2, … – GW-X – This alternative was developed in consideration of this guidance.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Monitored Natural Attenuation (MNA)	Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites	OSWER 9200.4-17P (April 21, 1999)	To Be Considered, if remedial alternative includes monitored natural attenuation	[The alternatives may not need to consider this TBC]	This TBC is not applicable to these alternatives.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – No MNA for this alternative, therefore not applicable. **[Note: If MNA is utilized as part of any groundwater alternative, the alternative should consider the MNA guidance.]**
Vapor Intrusion	OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air.	OSWER 9200.2-154 (June 2015)	To Be Considered	This guidance was considered to develop alternatives to address vapor intrusion risks.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative will comply with this TBC through the excavation and off-site disposal of contaminated soil that is a vapor source. Vapor mitigation ICs will address any remaining risks associated with remaining contaminated soil left on site that is a vapor source.	This TBC is not applicable to these alternatives. **[Note: Olin should assess the vapor risks associated with DAPL and other groundwater sources and may need to correct the statement, above]**
State Standards						
Hazardous Waste Identification	Massachusetts Hazardous Waste Management Rules for Identification and Listing of Hazardous Wastes	310 CMR 30.100	Applicable; Relevant and Appropriate	The Massachusetts hazardous waste regulations supplement federal RCRA requirements. Any wastes generated during remedial activities will be analyzed under these standards to determine whether they are listed or characteristic hazardous waste. Non-hazardous wastes will be disposed of appropriately.	SS-1 – No action, therefore not applicable SS-2, … – SS-X –All soil and sediment determined to contain hazardous waste that is excavated will be managed as a hazardous waste.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – All groundwater/DAPL determined to be a listed or characteristic hazardous waste that is extracted will be managed as a hazardous waste and disposed of off-site at a licensed facility.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Hazardous Waste – Generator Standards	Massachusetts Hazardous Waste Management Rules – Requirements for Generators	310 CMR 30.300	Relevant and Appropriate for non-listed hazardous waste left in place; Applicable for listed wastes that still display characteristics or for hazardous wastes generated as part of a cleanup (e.g., extracted groundwater/DAPL or excavated soil/sediment)	Any waste generated during remedial activities that is determined to be hazardous waste will be managed in accordance with these regulations. Alternatives generating hazardous waste or using treatment, storage or disposal facilities for hazardous waste will be implemented to comply with this ARAR.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – All soil and sediment determined to contain hazardous waste that is excavated will be managed as a hazardous waste. Under this alternative, any generation, treatment, or storage of hazardous waste will comply with ARAR through appropriate design, implementation, and operation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X –All groundwater/DAPL determined to be a listed or characteristic hazardous waste that is extracted will be managed as a hazardous waste and disposed of off-site at a licensed facility. Under this alternative, any generation, treatment, or storage of hazardous waste will comply with ARAR through appropriate design, implementation, and operation.
Hazardous Waste – Facility Standards	Massachusetts Hazardous Waste Rules – Management Standards for All Hazardous Waste Facilities	310 CMR 30.500	Relevant and Appropriate for non-listed hazardous waste left in place; Applicable for listed wastes that still display characteristics or for hazardous wastes generated as part of a cleanup (e.g., extracted groundwater/DAPL or excavated soil/sediment)	Any waste generated during remedial activities that is determined to be hazardous waste will be managed in accordance with these regulations. Alternatives generating hazardous waste or using treatment, storage or disposal facilities for hazardous waste will be implemented to comply with this ARAR.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – All soil and sediment determined to contain hazardous waste that is excavated will be managed as a hazardous waste. Releases from regulated hazardous waste facilities will be addressed under applicable closure/post-closure regulations. Under this alternative, any generation, treatment, or storage of hazardous waste will comply with ARAR through appropriate design, implementation, and operation. [**Note – capping alternatives are not currently addressed here; Olin will need to revise to address this issue**]	GW-1 – No action, therefore not applicable GW-2, … – GW-X – All groundwater/DAPL determined to be a listed or characteristic hazardous waste that is extracted will be managed as a hazardous waste and disposed of off-site at a licensed facility. Releases from regulated hazardous waste facilities will be addressed under applicable closure/post-closure regulations. Under this alternative, any generation, treatment, or storage of hazardous waste will comply with ARAR through appropriate design, implementation, and operation.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Hazardous Waste – Wastewater Treatment	Massachusetts Hazardous Waste Management Rules – Special Requirements for Wastewater Treatment Units	310 CMR 30.605	Applicable, if hazardous waste is treated in tanks prior to discharge to a POTW.	Any waste generated during remedial activities that is determined to be hazardous waste will be managed in accordance with these regulations, if applicable. Alternatives treating hazardous waste in tanks prior to discharge to a POTW will be implemented to comply with this ARAR.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Under this alternative, any treatment of hazardous waste in tanks prior to discharge to a POTW will comply with ARAR through appropriate design, implementation, and operation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Under this alternative, any treatment of hazardous waste in tanks prior to discharge to a POTW will comply with ARAR through appropriate design, implementation, and operation.
Hazardous Waste – Cap Standards	Massachusetts Hazardous Waste Rules – Landfill Closure and Post Closure Care	310 CMR 30.633	Relevant and Appropriate for non-listed hazardous waste left in place; Applicable for listed wastes that still display characteristics or for hazardous wastes generated as part of a cleanup (e.g., extracted groundwater/DAPL or excavated soil/sediment)	Alternatives generating hazardous waste or using treatment, storage or disposal facilities for hazardous waste will be implemented to comply with this ARAR.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This ARAR is not applicable to this alternative. (If hazardous waste is capped in place, these performance standards for a protective cap will be met.)	GW-1 – No action, therefore not applicable GW-2, … – GW-X – This ARAR is not applicable to this alternative. (If hazardous waste is capped in place, these performance standards for a protective cap will be met.)
Hazardous Waste – Groundwater	Massachusetts Hazardous Waste Management Rules – Groundwater Protections	310 CMR 30.660	Applicable	Any hazardous waste generated by the remedial alternative will be managed to prevent contaminant migration to groundwater.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Extraction and off-site disposal of soil/sediment contaminated with hazardous waste will protect groundwater quality through appropriate design, implementation, and operation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Extraction and off-site disposal of groundwater/DAPL will protect groundwater quality through appropriate design, implementation, and operation.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Hazardous Waste – Containers	Massachusetts Hazardous Waste Management Rules - Containers	310 CMR 30.680	Applicable, if hazardous waste generated on site is managed in containers	Establishes requirements for the management of containers, such as drums, that are used to store hazardous wastes.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any hazardous waste generated by the remedial alternative that is managed in containers will comply with ARAR through appropriate design, implementation, and operation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any hazardous waste generated by the remedial alternative that is managed in containers will comply with ARAR through appropriate design, implementation, and operation.
Hazardous Waste - Tanks	Massachusetts Hazardous Waste Management Rules – Management, Storage and Treatment in Tanks	310 CMR 30.690	Applicable, if hazardous wastes generated on site is managed in tanks	These standards specify requirements for tank systems used to store or treat hazardous waste. Provides specifications for design and installation of tank systems. Requires secondary containment, leak detection systems, and inspections. Identifies general operating requirements, and closure and post-closure care.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any hazardous waste generated by the remedial alternative that is managed in tanks will comply with ARAR through appropriate design, implementation, and operation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any hazardous waste generated by the remedial alternative that is managed in tanks will comply with ARAR through appropriate design, implementation, and operation.
Discharges to Surface Waters	Massachusetts Clean Water Act; Surface Water Discharge Permit Regulations	MGL c. 21, §§ 26-53; 314 CMR 3.00	Applicable, if surface water discharge occurs	Alternatives that incorporate discharges to surface waters will need to have the discharges meet the substantive discharge standards of the Massachusetts Surface Water Discharge Permit (314 CMR 4.00).	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any discharge to surface water from soil/sediment excavation/ management and excavation dewatering will be treated to meet these standards.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any discharge to surface water from groundwater/DAPL extraction will be treated to meet these standards.
Surface Water Quality Monitoring	Massachusetts Clean Water Act; MA Surface Water Quality Standards (MSWQS)	M.G.L. c. 21, §§ 26-53; 314 CMR 4.00	Applicable	Alternatives that incorporate discharges to surface waters will need to have the discharges meet the MSWQS.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any discharge to surface water from soil/sediment excavation/ management and excavation dewatering will be treated to meet these standards.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any discharge to surface water from groundwater/DAPL extraction will be treated to meet these standards.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Hazardous Waste – Facility Discharge Standards	Massachusetts Supplemental Requirements for Hazardous Waste Management Facilities	MGL c. 21, §§ 26-53; 314 CMR 8.00	Relevant and Appropriate	Alternatives that incorporate discharges to surface waters will need to have the discharges meet these standards.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Any discharge to surface water from soil/sediment excavation/ management and excavation dewatering will be treated to meet these standards before discharge to surface waters.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any discharge to surface water from groundwater/DAPL extraction will be treated to meet these standards before discharge to surface waters.
Discharges from Treatment Works or to a Publicly Owned Treatment Works (POTW	MassDEP Operation, Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Dischargers	314 CMR 12.00	Applicable, if discharges to a POTW occur	If remedial activities result in discharges to a POTW, the discharge will be monitored and treated, if necessary, to comply with pretreatment standards.	SS-1 – No action, therefore not applicable SS-2, … – SS-X –Any water generated during soil/sediment excavation/ management and excavation dewatering will be treated, if necessary, to meet these standards, if the water is to be discharged to a POTW.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Any water generated during groundwater/DAPL extraction will be treated, if necessary, to meet these standards, if the water is to be discharged to a POTW.
Underground Injection	Massachusetts Underground Injection Control Regulations	310 CMR 27.00	Applicable, if alternatives use underground injection	The alternatives developed in this FS do not have underground injection as a component of a treatment train. However, if the alternatives incorporate re-injection or infiltration of treated water, both these and the federal regulations will be considered.	This ARAR is not applicable to these alternatives.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – No underground injection, therefore not applicable. (If any groundwater alternative involves underground injection – This alternative will comply with ARAR through appropriate design, implementation, monitoring and treatment, if necessary.)

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Groundwater	Massachusetts Groundwater Discharge Permit Program	314 CMR 5.00	Applicable, if treated groundwater effluent is planned to be discharged to groundwater	If treated groundwater is reinjected into the aquifer, the discharge of any pollutant to groundwater will be controlled so that groundwaters are protected for their actual and potential use as a source of potable water and surface waters are protected for their existing and designated uses.	This ARAR is not applicable to these alternatives.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – No discharge to groundwater, therefore not applicable. (If any groundwater alternative involves discharge to groundwater – This alternative will comply with ARAR through appropriate design, implementation, monitoring and treatment, if necessary.)
Groundwater, Surface Water and Gas Monitoring	Massachusetts Solid Waste Management Regulations – Ground Water, Surface Water and Gas Monitoring Systems	310 CMR 19.118	Relevant and Appropriate	Solid waste facility standards for monitoring groundwater.	SS-1 – No action, therefore not applicable SS-2, … – SS-X - This ARAR is not applicable to this alternative. (For any capping alternative, monitoring of the cap will ensure that groundwater is not impaired by the capped contamination.)	GW-1 – No action, therefore not applicable GW-2, … – GW-X - This ARAR is not applicable to this alternative. (For any capping alternative, monitoring of the cap will ensure that groundwater is not impaired by the capped contamination.)

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Air Emissions	Massachusetts Ambient Air Quality Standards	310 CMR 6.00	Applicable	Remedial activities will be implemented in accordance with these rules. No air emissions from remedial activities will cause air quality standards to be exceeded.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Soil/sediment excavation and management of contaminated soil/sediment will be implemented in accordance with these rules. Emission standards, including for dust, will be complied with during excavation and soil/sediment management.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Extraction and management of groundwater/DAPL and any groundwater/DAPL treatment will be implemented in accordance with these rules. If air stripping is selected during remedial design as a component of the groundwater/DAPL remedy, it will be designed, constructed, and operated in accordance with these requirements. Emission standards, including for dust, will be complied with during groundwater/DAPL extraction.
Air Emissions	Massachusetts Air Pollution Control Regulations	310 CMR 7.00	Applicable	Remedial activities will be implemented in accordance with these rules. No air emissions from remedial activities will cause air quality standards to be exceeded.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – Soil/sediment excavation and management of contaminated soil/sediment will be implemented in accordance with these rules. Emission standards, including for dust, will be complied with during excavation and soil/sediment management.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Extraction and management of groundwater/DAPL and any groundwater/DAPL treatment will be implemented in accordance with these rules. If air stripping is selected during remedial design as a component of the groundwater/DAPL remedy, it will be designed, constructed, and operated in accordance with these requirements. Emission standards, including for dust, will be complied with during groundwater/DAPL extraction.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
DAPL/NAPL Cleanup	Massachusetts Contingency Plan, NAPL	310 CMR 40.1003(7)	Relevant and Appropriate	Remedial activities will be implemented in accordance with these rules.	This ARAR is not applicable to these alternatives.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – Extraction and off-site disposal of groundwater/DAPL will address these standards, to the extent practicable. Any remnant groundwater/DAPL may be addressed by any further groundwater component of the remedy.
Institutional Controls	Massachusetts Contingency Plan, Implementation of Activity and Use Limitations	310 CMR 40.1070(4)	Relevant and Appropriate	Institutional controls will be established consistent with state standards for enforceable restrictions on contaminated property to prevent human contact with contamination and to protect remedial infrastructure.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative includes removal of all soil that poses a commercial/industrial/recreational risk and the use of notices of activity and use limitations as ICs to prevent residential exposure to remaining contaminated soil.	GW-1 – No action, therefore not applicable GW-2, … GW-X – This ARAR is not applicable to these alternatives. [**Note: This ARAR analysis assumes that the GW/DAPL alternatives in the Source Control FS do not seek to limit exposure to GW/DAPL via an IC (and would have the further GW FS address this); if, in fact, an IC is a part of any of these alternatives, then the language here will need to be revised.**]
Monitoring Wells	Massachusetts Standard References for Monitoring Wells	WSC–310-91	To Be Considered	Monitoring wells will be installed, maintained and decommissioned based on these guidance standards.	This TBC is not applicable to these alternatives.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – This alternative will comply with these monitoring wells guidance standards.

Action/Trigger	Requirement	Citation	Status	Actions to be Taken to Attain Requirement	Soil/Sediment Alternatives	Groundwater Alternatives
Sediment/Erosion Control; Stormwater Management	Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas	Prepared for Massachusetts Executive Office of Environmental Affairs (original print March 1997; reprint May 2003)	To Be Considered	Remedial activities will be managed to control erosion and sedimentation.	SS-1 – No action, therefore not applicable SS-2, … – SS-X – This alternative will be managed to control erosion and sedimentation.	GW-1 – No action, therefore not applicable GW-2, … – GW-X – This alternative will be managed to control erosion and sedimentation.

APPENDIX 7

EPA Comments on Draft Operable Unit 3 Feasibility Study (March 30, 2018)
Olin Chemical Superfund Site, Wilmington, Massachusetts

GENERAL COMMENTS

1. Olin submitted two separate draft Feasibility Study reports, one for OU1/OU2 and one for OU3. Please see Appendix 6, for comments on how these two separate reports shall be combined and developed. For the purposes of these comments, the FS focused on identifying and evaluating source control alternatives for all OUs is referred to as the "Source Control FS." For the purposes of these comments, the FS that will include a full range of groundwater response alternatives that restore the aquifer is referred to as the "Further Groundwater Response Action FS" or "Further Groundwater FS."

2. Numerous inadequacies identified in the Draft OU3 FS Report stem from issues with the Draft OU3 RI Report. Olin shall revise the Draft OU3 RI Report in accordance with EPA comments and submit the Source Control FS Report which incorporates these changes.

3. The RAOs developed for OU3 are inadequate and shall be revised as follows:

   i. Currently stated: For overburden and bedrock groundwater within Zone II of the Municipal Water Supply Wells (MWSWs) in the Ipswich watershed and the zone of contribution to two residential wells on Cook Avenue in the Aberjona watershed: prevent exposure via potable use to constituents of concern at concentrations that are 1) associated with cancer risk greater than 1x10-4 and/or hazard Index greater than one, and 2) above drinking water Maximum Contaminant Levels.

      Revise to state: Restore contaminated groundwater to concentrations allowing for unrestricted use (achieve a cancer risk less than 1e-6 and a non-cancer hazard index of less than one for ingestion/dermal contact/vapor inhalation) of potable groundwater in both impacted watersheds. Minimize to the extent practicable the migration of contaminated groundwater and prevent the discharge of contaminated groundwater to surface water.

   ii. Currently stated: Prevent exposure to DAPL.

      Revise to state: Prevent human exposure to DAPL and groundwater containing contaminants exceeding ARARs and risk-based concentrations.

   iii. Currently stated: Reduce, to the extent practicable, mobility or volume of DAPL constituents in the DAPL pools that present a source of long-term impacts to groundwater and surface water.

      Revise to state: Prevent migration of DAPL and contaminated groundwater acting as a source (including penetration into bedrock), diffusion into groundwater, and discharge to surface water.

4. Olin states that TMPs in groundwater are currently being partially addressed by the LNAPL extraction system. However, there is no detailed discussion of the impacts to groundwater. In the Source Control FS Report, Olin shall discuss the groundwater impacts in greater detail and explain why this area of contamination is not considered for further remedial action in the FS. If appropriate, Olin shall develop RAOs and remedial alternatives to address groundwater impacts and residual LNAPL.

5. The potential presence of DAPL in bedrock has not been adequately discussed. While this issue is discussed in the Draft OU3 RI Report, that discussion is incomplete (see Appendix 1 comments). Olin shall develop alternatives to address the presence of DAPL and contaminated groundwater in bedrock fractures.

6. In EPA's December 7, 2017 comments on Olin's Draft Focused Feasibility Study Report for OU3 DAPL, Olin was directed to substantiate or remove claims that convective mixing of contaminants in groundwater during Facility operations was the primary cause of groundwater contamination in the overlying aquifer. Ongoing diffusion from DAPL was dismissed as a minor source. This issue was not corrected in the Draft OU3 FS Report, and Olin has still failed to provide any evidence to support these claims. Olin shall provide data supporting these statements or remove them from all FS reports.

7. The Draft OU3 FS Report largely defers a discussion of the integrity of the slurry wall to the Draft OU1/OU2 FS Report. Please see Appendix 6 on the need to provide a more robust discussion of the slurry wall in the Source Control FS Report.

8. In EPA's December 7, 2017 Comment Letter, Olin was directed to remove statements that potential human exposure to DAPL is unrealistic. In the Draft OU3 FS Report, these claims persist. As previously stated by EPA, the majority of DAPL is located off of Olin's property and extends approximately ¾ of a mile to the west-northwest. The DAPL pools are located under homes and active businesses and there are no ordinances or other controls to prevent private owners from installing wells or conducting activities that could result in exposure. Olin shall delete all statements implying that exposure to DAPL is unrealistic as these statements will not change the RAOs for the Site.

9. The Draft OU3 FS Report does not adequately indicate how the "primary COCs" for OU3 were developed (risk based, mass based, distribution based, etc.). Olin shall provide a discussion of how the primary COCs were determined in the Source Control FS Report.

10. The remedial alternatives developed to address OU3 contamination are inadequate and poorly developed. Issues include:

- Lack of alternatives for DAPL containment and or removal. In the alternatives proposed by Olin, the only source control action for DAPL is extraction from the Off-PWD DAPL Pool, and this source control measure is poorly developed (Olin only evaluated the continued operation of the one existing DAPL extraction well). There are no alternatives proposed in which DAPL is removed from the Containment Area, the Main Street DAPL pool, and bedrock. Olin shall evaluate alternatives in which all known DAPL areas are contained or removed from the bedrock and overburden. Olin shall evaluate an appropriate range of pumping alternatives (i.e., multiple wells, horizontal wells, etc.) within each of these DAPL extraction areas. See General Comment 11, below, for further explanation regarding the need to address DAPL as a source control measure and to evaluate a more expansive range of alternatives for DAPL containment/removal.

- Lack of alternatives for pumping or treatment of the contaminated groundwater in the overburden and shallow bedrock to manage the further migration. Of the alternatives proposed by Olin, the only groundwater treatment alternative included in the FS involves well-head treatment at the Town wells and MNA (see General Comment 12, below). Olin shall evaluate a full range of remedial alternatives for containing and treating contaminated overburden and bedrock groundwater (i.e., plume extraction wells, bioremediation, etc.).

- Failure to adequately consider bedrock groundwater contamination. EPA acknowledges Olin's intent to submit a technical impracticability waiver based on back diffusion of contaminants in bedrock. However, EPA does not currently consider treatment of groundwater in the bedrock fractures to be technically impractical based on the information available. The Source Control FS Report shall contain a robust analysis of a full range of alternatives for extraction and treatment of contaminated groundwater within bedrock fractures.

- Failure to address contamination in the Aberjona Watershed. MassDEP has determined that the groundwater in the Aberjona Watershed has a high use and value. Therefore, Olin shall evaluate a full range of remedial alternatives to address contamination within the Aberjona Watershed.

- The screening of the remedial alternatives focuses solely on NDMA. All FS reports shall consider the effectiveness of the remedial alternatives on all COCs evaluated in the revised Draft OU3 RI Report. This includes contaminants which were not released from the Facility, but have been solubilized in the aquifer (e.g., arsenic) as a result of the geochemical conditions created by Site releases.

- Due to the lack of remedial alternatives considered in the Draft OU3 FS Report, the associated ARAR analysis is similarly deficient. All FS reports shall contain a detailed analysis of each remedial alternative that summarizes which requirements are applicable or relevant and appropriate (or TBC) for each alternative and describes how each alternative meets these requirements. When an ARAR will not be met, the basis for justifying one of the six ARAR waivers provided by CERCLA § 121(d)(4) shall be discussed. EPA reserves the right to provide further comments regarding the ARAR analysis completed in all FS reports.

11. As stated above, Olin shall evaluate a full range of remedial alternatives for source control of the contaminated groundwater in the overburden and shallow aquifers that continue to migrate uncontrolled. In evaluating DAPL source control remedial alternatives, Olin shall consider the following:

    - The Source Control FS Report shall include a discussion of principal threat waste ("PTW") at the Site. DAPL and other media (e.g., holding basin soils and sediment) shall be included in this discussion. For any wastes determined to be PTW, Olin shall explain how the remedial alternatives proposed to address those wastes satisfy the NCP's expectation that treatment is used to address PTW wherever practicable.

    - EPA does not agree with Olin's assertion that DAPL and diffuse contaminated groundwater resulting from DAPL's presence is "stable." The basis for EPA's position is presented in EPA's July 13, 2017 Statement of Position responding to Olin's dispute. Section III.B. contains a detailed summary of the trend analysis performed by EPA and its contractor and the conclusions of this analysis. EPA's position on this technical issue has not changed following a complete review of the Draft OU3 RI Report. The data and trend analysis do not support Olin's conclusion that the groundwater plumes are stable. In the Source Control FS Report, Olin shall delete all statements that the DAPL and associated groundwater plumes are stable. Olin shall include a discussion of the trend analysis conducted by EPA as presented in Section III.B. of the July 13, 2017 Statement of Position. Furthermore, the Source Control FS Report shall include alternatives that manage the further migration of contamination in the overburden and bedrock aquifers.

    - Contrary to Olin's assertion, the DAPL Pools and the diffuse groundwater contamination resulting from ongoing diffusion present a threat of future exposure. Olin's installation of an alternative water line does not negate the need to evaluate the threat of future exposure. The majority of the DAPL and the diffuse and overlying plumes are located off of Olin's property and extend approximately three-quarters of a mile to the west-northwest, located under many homes and active businesses. It is possible that private owners could be exposed to DAPL, the diffuse plumes and other contaminated groundwater. The lifetime risk for a person consuming either DAPL or overlying diffuse groundwater resulting from the presence of the DAPL pools would exceed the upper end of EPA's acceptable risk range. In the Source Control FS Report, Olin shall include a robust discussion of the threat of future exposure to Site-related contamination and include appropriate RAOs to address these threats.

    - MassDEP has determined that the Site aquifer has a high use and value, and the Town of Wilmington has expressed a desire for restoration of the drinking water aquifer. EPA policy dictates that remediation programs should defer to state determinations of current and future groundwater uses, when based on an EPA-endorsed Comprehensive Ground Water Protection Program ("CSGWPP") that has provisions for site-specific decisions. The Commonwealth of Massachusetts has a core CSGWPP endorsed by EPA and routinely uses Groundwater Use and Value determinations for CERCLA sites located in Massachusetts. EPA must evaluate actions to restore and protect this aquifer consistent with the Commonwealth's designation of high use and value. A principal component of aquifer restoration will necessarily involve source control.

12. Olin's recommended alternatives rely on monitored natural attenuation ("MNA") as the principal component of the remedy. Olin has not presented any evidence (groundwater trends, statistics, plume maps, etc.) that MNA is occurring.

    Additionally, alternative 2, part of Olin's recommended alternatives, uses MNA as a principal component of the remedy without attempting source control, as required by EPA's MNA guidance (https://semspub.epa.gov/src/document/HQ/159152). The guidance states, in part:

    - "Sources of contamination are more appropriately addressed by engineered removal, treatment or containment technologies";
    - "Source control measures should be evaluated as part of the remedy decision process at all sites, particularly where MNA is under consideration as the remedy or as part of the remedy component"; and
    - "EPA, therefore, expects that source control measures will be evaluated for all contaminated sites and that source control measures will be taken at most sites where practicable."

    In the Further Groundwater FS Report, Olin shall provide a robust discussion of the efficacy of MNA on the groundwater plume. Any alternatives which propose MNA shall have source control as a principal component of the alternative.

13. There are statements throughout the Draft OU3 FS Report which purport EPA approval of certain findings and conclusions. Some of these statements are not supported by the record. To the extent such statements are made in all FS reports, they shall only be included if a source reference can be provided (i.e., cite an EPA approval letter).

SPECIFIC COMMENTS

1. Page 1-1, Section 1.0 – Olin states: "A Draft Remedial Investigation (RI) Report has been developed by Olin Corporation (Olin) for Operable Unit 3 (OU3) at the Olin Chemical Superfund Site (OCSS) in Wilmington, MA. The RI Report has been prepared simultaneously with this OU3 Feasibility Study (FS) Report on March 30, 2018 at the request of the United States Environmental Protection Agency (USEPA)." See Appendix 1, General Comment 6, and Appendix 6, General Comment 1, explaining how the FS Reports shall be combined and developed.

2. Page 1-3, Section 1.2, final paragraph – Olin shall modify this paragraph to note that the Town of Wilmington continues to maintain the water supply wells with the intent of re-activating them in the future.

3. Page 1-5, Section 1.3 – Olin states: "Olin completed closure of the Lined Lagoons as part of the closure activities initiated in 1986 (MACTEC, 2007) and completed in accordance with closure plans approved by MassDEP." Olin shall provide documentation of this approval and a discussion of any residual soil contamination.

4. Page 1-5, Section 1.3 – Olin states: "The alignment borings were initial targets for depth to bedrock; however, where weathered bedrock was encountered at excavation, several additional feet of bedrock were typically excavated to ensure the slurry wall connected to more competent bedrock." This statement directly contradicts Olin's claim of competent bedrock beneath the Containment Area. Olin shall provide a more in-depth description of the bedrock material encountered during slurry wall construction, as well as copies of any reports discussing the construction of the slurry wall.

5. Page 1-6, Section 1.3 – Regarding the bulleted list concerning the effectiveness of the Containment Area, see Appendix 2. Olin shall revise accordingly.

6. Page 1-6, Section 1.3, bullet 2 – The SASRs do not provide water level information for deep overburden or bedrock monitoring points within the containment cell; therefore, the vertical gradient cannot be calculated from those reports. EPA is aware of only one set of paired deep/shallow water levels measured in 2016 (not included in the Draft OU3 RI Report). Olin shall revise this statement accordingly.

7. Section 1.4 – Olin shall revise this section of the report in accordance with EPA's comments on the Draft OU3 RI Report.

8. Page 1-7, Section 1.4.1 – Olin states: "Potable use of groundwater does not pose an unacceptable risk at the residential wells evaluated." This statement shall be revisited following EPA's approval of the revised risk assessment for these wells which considers an NDMA inhalation factor.

9. Page 1-8, Section 1.4.1 – Olin states: "Other risk contributors that are not associated with the releases from the OCSS include 1,2-dichloroethane (1,2-DCA), benzene, cis-1,2-dichloroethene (cis-1,2-DCE), naphthalene, trichloroethene (TCE), and vinyl chloride (VC)." Olin shall provide documentation explaining why these commonly used chemicals would not have been used or present as contaminants at the Facility.

10. Page 1-8, Section 1.4.2 – Olin states: "Groundwater impacts in the MMB aquifer are primarily deep, occurring in the deep overburden and underlying bedrock." This statement is misleading and shall be revised or removed from all FS reports. While concentrations of NDMA and other contaminants of concern are generally higher deeper in the overburden, NDMA concentrations

are high (relative to the tap water RSL) in most of the overburden. Olin shall provide additional figures that indicate the extent of vertical contamination, addressing the larger plume of NDMA that extends well above the limits of DAPL and the "diffuse layer" as defined by Olin.

11. Page 1-8, Section 1.4.2 – EPA does not agree that the evidence provided in the Draft OU3 RI Report or Draft OU3 FS Report clearly indicates pumping of the overburden wells would pull in contamination from bedrock. Specifically:

    a. 1st bullet – The contaminant concentrations around the wells closest to the Chestnut Street pumping wells (GW-103D, GW-103BR, GW-63D, and GW-63S) do not appear to indicate a clear trend.
    b. 2nd bullet – Detected NDMA concentrations are very limited at wells closest to the Chestnut Street pumping wells (GW-103D, GW-103BR, GW-63D, and GW-63S), as only three or four data points are available and there is a significant data gap prior to the RI sampling.

12. Page 1-11, Section 1.4.2 – Olin's claims regarding greywater acting as a source of NDMA requires significant further evaluation. The cursory dismissal of the possibility that NDMA contamination found in these residential wells may be Site-related is unacceptable. If the presence of NDMA at these wells does not fit the conceptual site model, then the conceptual site model may need to be re-evaluated. Olin shall expound upon this section of the report significantly in the revised Draft OU3 RI Report and all FS reports.

13. Pages 1-14 and 1-15, Section 1.4.5 – Olin shall add a discussion of the effects of the pumping of the Town wells on the watershed divide, and on the shallow bedrock network.

14. Section 1.5 – Olin shall revise this section in accordance with EPA's comments on the OU3 Draft RI Report.

15. Page 1-17, Section 1.5.2 – Olin states: "Based on existing conditions, groundwater use restrictions, and the nature of DAPL…there is no current or foreseeable receptor for DAPL exposure." This approach is not consistent with EPA guidance as it fails to appropriately characterize the possible risks. Olin shall revise in accordance with comments on the Draft OU3 RI Report.

16. Page 1-18, Section 1.5.3 – Olin states: "Based on its physical characteristics alone, it is unreasonable to expect that consumption of DAPL is a reasonably foreseeable exposure scenario. Therefore, there is no foreseeable physical exposure to DAPL that would potentially cause an unacceptable risk." EPA disagrees with this statement, as explained in comments on the Draft OU3 RI Report. Olin shall delete these statements from the Source Control FS Report.

17. Page 1-18, Section 1.5.3 – Olin shall provide figures (plans and profiles) for all contaminants listed below to define the extent of contamination in the revised Draft OU3 RI Report and all FS reports:

    a. Core of the Ipswich overburden plume: NDMA, biphenyl, chloroform, antimony, arsenic, cobalt, iron, manganese, nickel, and vanadium.
    b. Core of the Ipswich bedrock plume: NDMA, 2,4,4-Trimethyl-1-pentene, chloroform, hydrazine, antimony, arsenic, cobalt, iron, manganese, nickel, and vanadium.

18. Page 1-20, Section 1.5.3 – Olin states: "The configuration and nature of this impact is a technical barrier to aquifer restoration, including the overburden in the MMB aquifer. Extraction of groundwater from the overburden aquifer will result in vertical contribution of underlying impacted bedrock groundwater." Olin has not presented any evidence to support this claim beyond theoretical modeling. These statements cannot be made with confidence and shall be modified to express the uncertainty or removed from all FS reports.

19. Section 1.6 – Olin shall revise this section in accordance with EPA's comments on the Draft OU3 RI Report.

    Page 1-21, Section 1.6 – Olin states: "Although there is no reasonably foreseeable exposure to DAPL, the FS should address migration of dissolved constituents in the Ipswich watershed associated with DAPL and DAPL as an ongoing source of those constituents." EPA disagrees there is no reasonably foreseeable exposure to DAPL, as explained in comments on the Draft OU3 RI Report. Olin shall revise accordingly.

20. Page 1-21, Section 1.6 – As discussed in EPA's comments on the Draft OU3 RI Report, the following conclusions from the Draft OU3 RI Report are inaccurate and or unsupported:

    a. "Bedrock underlying the DAPL pools and bedrock within the WBV under the region of diffuse groundwater have had long term impacts from high concentrations of NDMA. These areas are believed to contain a mass retained by matrix diffusion that is significant enough to render treatment of bedrock groundwater by extraction and treatment technically infeasible." Olin has not provided sufficient evidence to support this claim and shall revise or remove the statement from the all FS reports.
    b. "Future use of the Town wells will induce an upward vertical gradient from underlying bedrock groundwater to deep overburden groundwater and therefore restoration of the MMB overburden aquifer to potable quality is not feasible in the foreseeable future." Olin has provided no evidence that operation of the Town wells would render restoration of the aquifer infeasible when the application of remedial technologies is considered. Olin shall revise or remove this statement from the all FS reports.
    c. "DAPL extraction will not remove all DAPL. As extraction progresses, DAPL naturally becomes less dense and less concentrated as the top of the pool is drawn downward. This will limit the effectiveness of DAPL extraction by gravity drainage in the long run."

Olin shall develop and evaluate remedial alternatives which will address this predicted problem.

d. "Extraction of DAPL will not result in attainment of groundwater restoration goals within a meaningful time frame." This statement is unsupported. Olin shall provide additional supporting evidence for this claim or revise or remove the statement from the all FS reports. Remedial alternatives which combine both DAPL extraction and other treatment technologies should work to address groundwater restoration within a reasonable timeframe. Also note the general comments above regarding revised RAOs for DAPL and groundwater.

21. Page 2-1, Section 2.1 – See General Comment 3, above, regarding revisions to the RAOs.

22. Section 2.1.4 – This section shall include the volumes of contaminated groundwater for each contaminant of concern. Note that these volumes may be different for each contaminant, and therefore this information may be better presented in a table. Olin shall revise accordingly.

23. Page 2-5, Section 2.2 – Olin mentions volume minimization/concentration of DAPL in Table 2.3-1. Such evaporation process is considered treatment; therefore, Olin shall add "treatment" to the list of general response actions for DAPL.

24. Section 2.3.2 – Olin shall include treatment alternatives for all the COCs, not just NDMA. At a minimum, Olin shall include available technologies based on UV irradiation (including UV and pulsed-UV/hydrogen peroxide), adsorption technologies (including GAC and zeolites), and biological methods (including fluidized bed bioreactor, propane biosparging).

25. Section 3.0 – Olin asserts repeatedly that it is important to limit DAPL-diffuse layer mixing and interactions. Technical information to support such assertions are limited, and the assertions appear to be speculative (i.e., mixing would lead to significant mineralization and soil clogging). Sufficient information has not been provided to support that this technical consideration should be weighted so heavily in the evaluation of remedial alternatives. Olin shall provide an expanded discussion of this concern and revise remedial alternatives accordingly.

26. Page 3-3, Section 3.2 – The RAOs shall be revised in accordance with General Comment 3, above.

27. Page 3-3, Section 3.2 – The list of alternatives is poorly developed. It fails to consider DAPL extraction from all DAPL areas. It fails to propose groundwater treatment across the Site beyond extraction through the MWSWs, which is inadequate. Only one alternative (alternative three) addresses non-DAPL contamination, and inadequately so. The FS has no provisions for addressing NDMA contamination that extends to the southeast of the Site in overburden and bedrock. Groundwater contaminated by the Olin property has migrated a significant distance to the southeast and has the potential to impact drinking water and sensitive ecological receptors to the southeast. It is irrelevant that Halls Brook holding area may be contaminated in part by another PRP; the Site includes Olin's property and wherever contaminants have migrated. Olin

shall propose additional alternatives addressing these omissions, and carry an analysis of the alternatives through all FS reports. See also General Comment 11, above.

28. Page 3-5, Section 3.2.6 – In regard to the Cook Avenue wells consumption risk, Olin states: "However, whether risks will become apparent in the future cannot be predicted." This statement illustrates why alternative 4 is unacceptable. It would not be protective of human health given the dynamic nature of NDMA concentrations observed in the wells.

    Section 4.2 – Olin provides no justification for why DAPL from only the Off-PWD DAPL Pool would be extracted. Olin shall provide further explanation within this alternative, and also develop additional alternatives in which DAPL is extracted from all known DAPL areas (see General Comment 11, above).

29. Additionally, alternative 2 proposes using MNA as a principal component without attempting source control, as required by EPA's MNA guidance. See General Comment 13, above. Olin shall revise accordingly.

30. Page 4-6, Section 4.2.5 – Olin states: "The time necessary to meet RAOs is likely on the order of thousands of years given the slow back-diffusion from the bedrock matrix." Olin fails to note here that leaving the DAPL pools, and DAPL in bedrock fractures, in place would result in many years of continued diffusion into the bedrock matrix, long before the reverse diffusion process would even begin. Olin shall modify this statement to make this point clear. Additionally, the EPA MNA Guidance (see General Comment 13, above) states that "MNA will be an appropriate remediation method only where its use will be protective of human health and the environment and it will be capable of achieving site-specific remediation objectives within a timeframe that is reasonable compared to other alternatives." Removing DAPL as a source control measure would likely decrease the timeframe to meet RAOs by hundreds if not thousands of years; therefore, MNA without attempted removal of all DAPL is not an appropriate remedy.

31. Page 4-6, Section 4.2.6 – Olin states: "This alternative reduces mobility and volume of COCs in DAPL through extraction and disposal." Olin fails to explain here that DAPL would only be extracted from the Off-PWD DAPL Pool, a small fraction of the DAPL present in the overburden and shallow bedrock at the Site. Olin shall modify this statement to make this point clear, in addition to developing alternatives in which all DAPL is extracted to the extent practicable, as discussed in General Comment 11, above.

32. Page 4-8, Section 4.3.6 – Olin states: "This alternative reduces the toxicity, and volume of contaminated groundwater through extraction and treatment. In addition, operation of the MWSWs will likely result in control of the groundwater plume, reducing mobility. Toxicity, mobility, and volume of DAPL are reduced via extraction to extent practicable." There are multiple inconsistencies in this statement. First, the treatment system added to the Town wells would only address NDMA, not the other Site-related contaminants in groundwater. Second, it is unclear how the re-activation of the Town wells would affect the stability of the groundwater plume and mobility of contaminants. Olin has not presented any data or modeling showing how

the pumping of these wells would affect the plume. Additionally, this statement does not clarify that under this alternative, DAPL would only be extracted from the Off-PWD DAPL Pool. Olin shall modify this statement accordingly, and provide further explanation/modeling describing the effect of the Town wells operation on the COCs.

33. Page 4-12, Section 4.6.2 – Olin states: "In addition, ceasing groundwater extraction from residential wells will allow the groundwater to return to its natural migration pathway and further protect other wells within the GW-1 area." Olin has not provided any evidence to support this claim. The drawdown from these wells could be having the opposite effect, in that they prevent more highly contaminated groundwater from reaching other nearby wells. Olin shall provide evidence for this claim or remove it from all FS reports.

34. Page 4-13, Section 4.7.1.1 – Olin states: "Alternatives 2 and 3 address the extraction of DAPL, to the extent practicable…" This is a misleading statement. These alternatives only propose extracting DAPL from the Off-PWD DAPL Pool. Olin shall modify or remove this statement.

35. Section 5 – Olin shall develop a more comprehensive set of alternatives (see General Comment 11, above) and select alternatives that satisfy the requirements of the NCP, are protective of human health and the environment, and comply with ARARs. Accordingly, the alternatives recommended by Olin are not acceptable to EPA.

36. Tables 2.1-1, 2.1-2 and 2.1-3 (ARARs Tables) - Olin shall replace Tables 2.1-1, 2.1-2, and 2.1-3 with new tables that use Appendix 6 - Attachment 1 (Potentially Applicable or Relevant and Appropriate Requirements and To Be Considered Advisories, Criteria or Guidance) and Appendix 6 - Attachment 2 (Evaluation of Compliance with ARARs and TBCs for All Media) as a starting point for further development in the Source Control FS Report. Appendix 6 - Attachment 1 includes tables of potentially applicable or relevant and appropriate requirements ("ARARs") and "to be considered" advisories, criteria or guidance ("TBCs") that are location-specific, chemical-specific, and action specific. Appendix 6 - Attachment 2 includes tables that show the required level of alternative-specific ARAR analysis required for an FS. The tables included in Appendix 6 - Attachment 2 are provided as examples only to show the level of ARAR analysis required for each remedial alternative included in all FS reports. Due to the lack of remedial alternatives developed and evaluated in the Draft OU3 FS Report, the associated ARAR analysis is similarly deficient. All FS reports shall contain a detailed analysis of each remedial alternative that summarizes which requirements are applicable or relevant and appropriate (or TBC) for each alternative and describes how each alternative meets these requirements. When an ARAR will not be met, the basis for justifying one of the six ARAR waivers provided by CERCLA § 121(d)(4) shall be discussed. EPA reserves the right to provide further comments regarding the ARAR analysis completed in all FS reports.

37. Table 2.1-3 – Olin shall include evaluation of the following remediation technologies / process options: thermal, chemical (ZVI), and enhanced bioremediation using propane.

38. Table 2.3-1 – Olin shall correct the following deficiencies:

a. The table does not consider remedial approaches that include combinations of technologies. Technologies were inappropriately screened out if they were not capable of achieving all the stated RAOs independently.
b. Technologies that were screened out solely because they are not able to treat NDMA should be retained to be evaluated in combination with methods that can treat NDMA.
c. The FS did not include a complete evaluation of ex-situ water treatment methodologies.
d. The FS did not include a complete evaluation of in-situ water treatment technologies, including in-situ geochemical fixation.
e. Groundwater extraction methods should include consideration of interceptor/extraction trench and/or directionally-drilled extraction wells.
f. Soil excavation shall be considered for the Containment Area.
g. ISCO shall be retained for groundwater treatment.
h. UV oxidation shall be retained for groundwater treatment.
i. Containment remedies shall include hydraulic containment response actions, such as groundwater extraction for hydraulic control.
j. In-situ grouting shall be retained as a possible containment remedy associated with bedrock groundwater contamination.
k. Soil freezing shall be considered as a possible containment remedy in combination with groundwater extraction and treatment in localized DAPL areas.

39. Figure 1.3-1 includes orange polygons that are not listed on the legend (source areas). Olin shall revise accordingly.

Appendix 8 - Comments from Stakeholders

CDM Smith SANBORN HEAD

Memorandum

To: *Wilmington Environmental Restoration Committee*

From: *CDM Smith and Sanborn Head*

Date: *May 25, 2018*

Subject: *Observations and analysis regarding the OU3 Human Health Risk Assessment*

CDM Smith and Sanborn Head write to provide WERC with some additional thoughts and considerations regarding the baseline human health risk assessment for OU3 beyond those intended for submission to EPA as official comments.

Baseline Human Health Risk Assessment

Summary: Consistent with EPA risk assessment guidance, the OU3 risk assessment focuses on "total" exposure to groundwater, which includes its ingestion as drinking water and contact through domestic uses, including contact with skin and inhalation of volatiles that off-gas from water. However, the OU3 risk assessment departs from standard default U.S. EPA guidance in the methods used to assess inhalation risks of n-nitrosodimethylamine (NDMA) that volatilizes from domestic water use. This results in substantially lower risk estimates than would be calculated with EPA's default Superfund guidance on indoor volatilization exposure pathways from domestic water use. AMEC's departure from the default guidance is justified in consideration of NDMA's low propensity to off-gas relative to other volatile chemicals, but the focus on the shower model excludes other domestic uses of water and potential exposure to NDMA in air at times outside of showering/bathing. Given the uncertainties associated with volatilization modeling, we think that EPA should, for the sake of risk management, apply an allowable risk criterion of 1 per million, or at most 10 per million (consistent with the state Massachusetts Contingency Plan), rather than the 100 per million upper-bound of the Superfund range as suggested by AMEC in the OU3 risk assessment.

Observations and Analysis: In Table 5.2-1 (Risk Summary Table), the current land use incremental cancer risk estimates for the individual private wells are all within the acceptable Superfund risk range of 1 to 100 per million. The highest value is 50 per million for the 5 Border Avenue location. That same location has the only calculated hazard index that exceeds 1, though in the summary the 1.2 value is rounded down to 1. These risks are arguably within the Superfund range and indicative of no significant risk. Incremental cancer risks at 11 of the 18 locations equal or exceed the MCP acceptable incremental cancer risk limit of 10 per million.

In cases for which NDMA is the only carcinogen among the chemicals of concern, the ratio of the oral/dermal cancer risk to the inhalation cancer risk is about 44 (range 42-46, likely the result of rounding and significant figures). This is quite different from values in the EPA Regional Screening Levels table, which indicates inhalation risk to be 3.5 times the ingestion/dermal risks. The OU3 risk assessment is estimating inhalation risks to be more than 100-fold lower than those estimated in the EPA RSL tables.

The comparative risks from the OU3 risk assessment and the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, using all of its default assumptions for the tapwater scenario) are as follows for the 5 Border Avenue location using an exposure point concentration of 24 ng/l (ppt) for NDMA:[1]

Scenario	Incremental Cancer Risk (per million) for 5 Border Avenue at an NDMA EPC of 24 ng/l			
	Ingestion	Dermal	Inhalation	Sum of Pathways
OU3 Risk Assessment (Table E-1, sum of adult and child)	49	0.1	1	50
EPA RSL Calculator	49	0.1	170	220

Note that the RSL Calculator indicates a total risk above the 100 per million upper limit of EPA's acceptable range, in most part due to the inhalation pathway that contributes very little to the OU3 risk assessment total. Also note that the OU3 risk assessment and the EPA RSL Calculator give the same result for the ingestion and dermal pathways, suggesting similar exposure and risk assumptions.

The implications are that, if the EPA RSL Calculator was used, incremental cancer risk estimates would exceed the acceptable Superfund upper limit for a number of the private wells (and in each of these cases, risks would be more than 10 times the acceptable limit under the state MCP program).

The EPA RSL Calculator model for inhalation exposure to volatiles from tap water is based on the simplistic assumption that "activities such as showering, laundering, and dish washing contribute to contaminants in the air for inhalation." This assumption is more encompassing than the OU3 risk assessment shower model. The RSL model is based on 1991 Superfund risk assessment guidance released subsequent to the 1987 Foster and Chrostowski model. Note that the EPA guidance was developed with knowledge of, and subsequent to, the Foster and Chrostowski model relied upon by the OU3 risk assessment.

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[1] These risks are comparable because NDMA is the only carcinogenic chemical detected/considered for the 5 Border Avenue location/well.

> "Based primarily on experimental data on the volatilization of radon from household uses of water, Andelman (1990) derived an equation that defines the relationship between the concentration of a contaminant in household water and the average concentration of the volatilized contaminant in air. In the derivation, all uses of household water were considered (*e.g.*, showering, laundering, dish washing). The equation uses a default "volatilization" constant (K) upper-bound value of 0.0005 × 1000 L/m^3. (The 1000 L/m^3 conversion factor is incorporated into the equation so that the resulting air concentration is expressed in mg/m^3.) Certain assumptions were made in deriving the default constant K (Andelman 1990). For example, it is assumed that the volume of water used in a residence for a family of four is 720 L/day, the volume of the dwelling is 150,000 L and the air exchange rate is 0.25 m^3/hr. Furthermore, it is assumed that the average transfer efficiency weighted by water use is 50 percent (*i.e.*, half of the concentration of each chemical in water will be transferred into air by all water uses [the range extends from 30% for toilets to 90% for dishwashers]). See the Andelman paper for further details."

Section 6.2.2.1 of the OU3 risk assessment explicitly discusses the reasons for departing from EPA's default Superfund guidance. Basically, AMEC argues that NDMA is not as volatile as the chemical's used by Andelman in the development of the default volatilization factor. The argument is valid, as NDMA is miscible in water and not likely to volatilize to a significant degree. However, the shower model is incomplete as it does not consider volatilization from other domestic uses of water such as cooking, clothes washing, and toilets, nor does it consider NDMA that remains indoors for periods outside of the assumed time of the shower.

Memorandum

To: *Wilmington Environmental Restoration Committee*

From: *CDM Smith and Sanborn Head*

Date: *May 25, 2018*

Subject: *Review of OU3 Remedial Investigation, Feasibility Study, and related documents*

CDM Smith and Sanborn Head have performed a review of selected aspects of the draft OU3 Remedial Investigation (RI), Feasibility Study (FS), the supporting draft Baseline Human Health Risk Assessment, and (as background) the previous OU1 & OU2 FS. We write to provide comments on these documents.

Overarching Comments

- Information is missing from the RI report that makes a comprehensive review impossible – it would be better to demand a complete document prior to engaging in a more detailed review.
- The FS report is limited in scope, and lacks the exploration of multiple remedial alternatives, bench-scale treatability studies, and other detailed studies that are necessary to determine source control measures and the feasibility of aquifer restoration.
- Additional study and exploration to supplement the RI/FS should not slow down interim source control actions. As an example, the off-site DAPL pools are likely an ongoing source of groundwater contamination and should be extracted as soon as possible. Other investigations, such as the Rock Matrix SWP, can proceed concurrently to further evaluate what measures may be taken to remove continuing sources of contamination to groundwater and hasten aquifer restoration.

OU3 Remedial Investigation

- Several tables listed in the Table of Contents are not included in the RI. Additionally, some tables included in the report are not included in the Table of Contents. Tables 4.1-1 through 4.3-1 as listed in the Table of Contents do not exist in the draft report. Table 4.3-1 does exist in the report but is not the same as what is reported in the contents. Tables 4.4-9 and 4.4-10 are not listed in the Table of Contents. Please provide these missing tables.

- Some figures refer to the Boston Harbor Drainage Basin (Figures 1.2-1 and 3.1-2) while the text refers to the Aberjona watershed. For clarity, please be consistent with the names of the drainage basins.

- Section 1.3.7 indicates DAPL in weathered bedrock at well GW-43D, however this well is not included within the area of the Off-PWD DAPL pool. Please modify the extent of the DAPL pool shown on the various figures to include this location or explain why this well is not included in the DAPL area.

- Please include a discussion of the chemistry of NDMA formation, possible precursors, possible sources at the site, summary of evaluations done regarding NDMA formation at the site, etc.

- Section 2.2.3: The text indicates that Table 2.2-2 lists wells proposed to be included in May and October 2011 synoptic water level rounds and a rationale for wells proposed but not measured. There does not appear to be any indication in Table 2.2-2 as to which wells were not monitored or why they were not monitored. Please update Table 2.2-2 to include this information.

- Please add a note indicating the vertical exaggeration on the cross-sections (Figures 3.2-5 and 3.2-6).

- There is an absence of data with which to fully evaluate groundwater flow in the vicinity of the site. Potentiometric maps are included for the May and October 2011 synoptic water level rounds; however, numerous monitoring wells were not included in these rounds (as indicated by the "NG" in Table 3.3-1). Some of the wells not gauged in 2011 were included in a December 3, 2015 synoptic water level round; however, potentiometric maps of the 2015 data are not included.

    - Please include potentiometric maps of the 2015 water level data for shallow overburden, deep overburden and bedrock monitoring wells.

    - Please include hydrographs of water level data for all locations. Data from wells within a cluster should be plotted on a single hydrograph so that vertical hydraulic gradients over time can be evaluated. Please include water level data collected when the public water supply wells were active as well as more recent data.

    - Table 3.3-5 is a summary of vertical hydraulic gradients but it does not include any bedrock monitoring wells. This table should be expanded to include, at a minimum, all well clusters with bedrock monitoring wells. Vertical hydraulic gradients should be calculated for multiple monitoring dates so that average gradients can be calculated and changes over time can be evaluated. Please include water level data collected when the public water supply wells were active as well as more recent data.

  - Please create figure(s) posting the vertical hydraulic gradient at each well cluster, include gradients between shallow and deep overburden, and between deep overburden and bedrock, at a minimum.
  - Please include potentiometric cross-sections.
  - Please expand the discussion of vertical hydraulic gradients, particularly focusing on areas near DAPL.
  - Please include potentiometric maps that represent conditions that existed when the public water supply wells were pumping.
  - Please expand the discussion of the location of the groundwater divide over time and include data used to support the evaluation.

- Sections 3.7 and 4.1 of the RI discuss groundwater use classifications. At a minimum, please include figures showing the location of these areas relative to the Site. Consider adding figure(s) showing these areas relative to the groundwater contamination.

- Please indicate the time period the data used to generate the Figure 4.4 series (showing nature and extent of contamination) covers. Please indicate what data, if any, are excluded.

- Figure 4.4.1-1c indicates NDMA detection in approximately half of the groundwater samples collected in the vicinity of the Mill Brook Country Day School. Please provide the data and discuss concentration trends?

- There does not appear to be an evaluation of groundwater quality over time. Please include plots of water quality data over time for NDMA, ammonia, and specific conductance (or another similar indicator of DAPL), at a minimum. Please evaluate and discuss whether the groundwater contamination is stable/expanding/shrinking in a) various geographic areas of the site and b) different geologic units. Please include references and the data that support the discussion and conclusions.

- Location and volume of DAPL – Section 4.2.3 discusses the location and volume estimates of the DAPL pools, but the RI does not appear to include supporting data. Please explain how the DAPL pools were delineated and include the monitoring data used to delineate them. Include data collected over time and discuss whether the DAPL pools are stable or expanding; provide supporting data. Explain how the DAPL volumes were estimated; include the calculations and data used to estimate the DAPL volumes.

- Table 4.3-1 provides summary statistics of analytical results in RI groundwater wells; however, it is broken up by watershed and geologic unit. Please revise Table 4.3-1 to include a single evaluation of all locations, regardless of geologic unit and watershed. Analytical results are being compared to EPA MCLs, however there are many compounds detected that do not have an MCL. A more thorough evaluation of applicable regulatory standards should be performed, and the analytical results should be compared to the minimum of the applicable standards for each compound. Please define the significance of the yellow highlighting. The "Frequency of Detection" is not defined: does this refer to the number of samples or the number of locations?

- Section 4.3.2 indicates that "a process was undertaken to identify and select a subset of analytes that could be used to represent the nature and extent of contamination." Please describe this process in detail. For each parameter that exceeded a screening value in Table 4.3-1 but is not included in subsequent tables, please document the rationale for the omission.

- The extent of NDMA impacts are drawn as a line along the northeastern property boundary. NDMA concentrations are elevated in the wells near this boundary (GW-307 with 1,300 ppt; GW-4D with 830 ppt) and there are no monitoring wells further to the northeast to define this extent (Figure 4.4.1-1b). In addition, there are no bedrock wells in this area with which to determine bedrock water quality in this area. Please remove the extent of NDMA boundary in this area or add "?" to indicate uncertainty.

- Section 5.1 – DAPL Pools – The text states that "DAPL concentrations have not increased in DAPL based monitoring data from 2003 – 2001." Please define "DAPL concentration." Please provide the monitoring data that support this statement.

OU3 Feasibility Study

- Alternatives Evaluated – It is unacceptable that the FS evaluates only three alternatives for remediation (Alternatives 1 through 3), one of which is the No Action alternative. Alternatives 4 through 6 present three additional alternatives for groundwater in the Cook Avenue area, but do not address the source areas of contamination. A complete FS for OU3 must evaluate alternatives for removing source areas including the Main Street DAPL pool and the Containment Area DAPL pool in addition to the Off-Property West Ditch (Off-PWD) DAPL pool. No consideration is given in the FS to addressing overburden and bedrock groundwater contamination aside from proposing monitoring or (in Alternative 3) considering extracting and treating groundwater via the existing municipal water supply wells (MWSWs).

- Please include a Remedial Action Objective aimed at restoring groundwater quality consistent with ARARs, so the aquifer can be used as a public water supply.

- The identification of potential ARARs is not sufficiently comprehensive. Please expand the ARARs evaluation. Examples of more comprehensive ARAR analyses for two other superfund Sites in Massachusetts can be found at:

  https://semspub.epa.gov/work/01/237033.pdf (see appendix C)

https://www3.epa.gov/region1/superfund/sites/industriplex/233379Tablespart1.pdf
(See Tables 2-1, 2-2, and 2-3)

These two ARAR analyses are included at Attachments 1 and 2 to this memorandum for reference.

- A range of treatment alternatives has not been developed. Please include alternatives aimed at eliminating contamination, to the extent practicable.

- More aggressive alternatives aimed at cutting off/controlling the source areas must be included. At a minimum, include various combinations of extraction and treatment/disposal of DAPL, diffuse groundwater and groundwater.

- Bench test results indicate that NDMA is not being formed in DAPL or diffuse groundwater. Please include time-concentration data from site monitoring wells to support this conclusion.

- The text states that the DAPL surface in the DAPL pools has remained stable over the last decade. Please include data to support this statement.

OU1 & OU2 Feasibility Study

- Alternatives Evaluated – Very few alternatives are considered for remediation. Other than the No Action alternative, the FS identifies only a single alternative with three different options for the type of cap on the containment area (Alternatives 2A, 2B, and 2C). Please add alternatives to the evaluation, including one or more alternatives evaluating source removal.

Baseline Human Health Risk Assessment

- The OU3 risk assessment lacks a systematic identification of chemicals of concern (COCs). All chemicals detected in groundwater should be considered COCs and carried through the risk assessment unless they can be eliminated via applicable screening criteria, specifically the U.S. EPA Regional Screening Levels (RSLs). If a chemical has been detected in groundwater in any well at a level exceeding the tapwater RSL, it should be identified as a COC for the risk assessment. If a chemical lacks an RSL, a site-specific screening-level should be determined for that chemical using the RSL methodologies unless there are valid, stated grounds for dismissing the chemical from the risk assessment (such as its recognition as an essential nutrient at levels consistent with the highest level detected in groundwater).

- The OU3 risk assessment should consider each individual groundwater well as a distinct exposure point consistent with procedures endorsed by the Massachusetts DEP. Groundwater wells should not be grouped together for determining exposure point concentrations unless there are valid, demonstrated reasons for combining data (such as two monitoring wells being sufficiently close together that a drinking water well, if installed, would necessarily draw water from both).

- The human health risk assessment gives no consideration to the MCP cancer risk limit of 1×10^{-5} and focuses only on the upper end of the cancer risk range. There is also a statement in the FS (p. 2-2) that the MCP is not considered an ARAR because sites regulated under CERCLA are considered adequately regulated. While the MCP does state that sites regulated under CERCLA are adequately regulated, why is no consideration given to meeting any cancer risk limit other than the upper end of the risk range? The MCP cancer risk limit is in the middle of the range (logarithmically).

- The OU3 risk assessment is based on the premise that the upper-end of the Superfund risk range is acceptable under all conditions. The acceptable risk level at each site is determined by EPA, and EPA has the discretion to choose a more protective target risk level if it is achievable. In this case, given the many years that some residents may already have been exposed to NDMA and other chemicals from the Olin site, a more protective criterion is appropriate. As stated above, a lower target risk level would also be more consistent with the risk-based target level of the Massachusetts Contingency Plan (MCP), which is 10 per million, or ten times lower than the target mentioned by the OU3 risk assessment. Note that this criterion is determined by EPA and should not even be implied as an acceptable limit within the OU3 risk assessment.The OU3 shower model may significantly underpredict potential exposure to NDMA via inhalation. The shower model is based on mass transfer of volatile chemicals from water droplets, and does not account for the effects of the water droplets evaporating per se. The OU3 risk assessment's departure from EPA's default methods for assessing risks of inhalation of volatiles from tapwater is justified to some extent by the low Henry's Law constant, but the simple shower model ignores the complexities of aerosol suspension and other more complex factors that affect exposure. The degree of uncertainty is large, as the use of EPA's default risk assessment methodology for assessing inhalation risks from household tapwater use yields exposure estimate 170 time higher (based on calculations generated by the EPA RSL Calculator). If EPA accepts the alternate model, it should do so in conjunction with a more stringent risk limit to compensate for the uncertainties between these models. As an alternative, experiments could be conducted to determine the concentrations of NDMA and other chemicals in air that result from volatile chemicals present in tapwater.

- An uncertainty discussion should be added to the OU3 risk assessment to discuss the effect of deviating from the default U.S. EPA methods to assess inhalation exposure to volatile chemicals from domestic water use.

- Please more clearly state the assumptions concerning inhalation exposure and the shower model. The shower model used in the OU3 risk assessment appears to be applied in a curious fashion and/or is poorly documented. Table 3.1-1 and elsewhere suggest that the volatile concentration in air is calculated at a time *t* double in length to the time of the shower *Ds*.

- The equation for concentration is not explained as to whether it represents an integral over time or a point in time – properly, it should presumably be an integral. If the concentration at the end of the period of exposure is applied over the entire exposure period, exposure may be misrepresented, and periods of exposure outside the bathroom (as air is exchanged throughout the home) are also not considered.

- The OU3 risk assessment considers inhalation of NDMA only during showering. Other domestic uses of water lead to volatilization of chemicals to indoor air, and air from the shower also circulates through the home leading to extended exposure at albeit lower levels. Total potential exposure to inhalation of volatiles should be considered at all times of day, with sources beyond showering and volatilization considered.

Attachment 1

ARARs Evaluation

W.R. Grace & Co. Superfund Site
Middlesex County, Massachusetts

Table C-1. ARARs and TBCs for Groundwater Remediation

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
CHEMICAL SPECIFIC ARARS			
Safe Drinking Water Act ("SDWA") National Primary Drinking Water Regulations Maximum Contaminant Levels ("MCLs"), 40 C.F.R. § 141.11-141.16, 141.60-141.62	Relevant and Appropriate	Maximum Contaminant Levels (MCLs) have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies. MCLs are applicable only at the tap, but are relevant and appropriate because the groundwater underneath parts of the Site may be used as a drinking water source. Table 2-4 lists the MCLs.	This alternative will attain MCLs.
Non-zero SDWA Maximum Contaminant Level Goals ("MCLGs"), 40 C.F.R. § 141.50-141.51.	Relevant and Appropriate	MCLGs, defined by SDWA regulations as the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety, are non-enforceable health goals under the SDWA. Because MCLGs are not enforceable regulatory standards, they are not applicable. However, they are relevant and appropriate because groundwater aquifers beneath parts of the Site may be used as a source for drinking water. Table 2-4 lists the MCLGs.	This alternative will attain non-zero MCLGs.
Massachusetts Drinking Water Regulations, 310 C.M.R. 22.06, 22.06B, 22.07A, 22.07B	Relevant and Appropriate	These regulations set forth Massachusetts MCLs ("MMCLs"), based on health and technical practicality, for public water systems. The aquifer on site is not a public water system, but the requirements are relevant and appropriate for those areas of the Site that are "GW-1" areas under the MCP, because the groundwater in those areas of the Site may be potentially used as a source for drinking water. When MMCLs are more stringent than federal levels, the state levels must be met. The MMCLs for 1,4-Dichlorobenzene (also known as para-Dichlorobenzene in 310 CMR 22.07B) and ethylene dibromide are more stringent than the MCLs. In addition, there is no MMCL for lead, which has been found at the site, but there is a Massachusetts "action level", similar to an MCL, for lead. Table 2-4 lists the MMCLs.	This alternative will attain MMCLs.

Table C-1. ARARs and TBCs for Groundwater Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Massachusetts Ground Water Quality Standards ("GWQS"), 314 C.M.R. 6.01-6.10	Relevant and Appropriate	The GWQSs, based on health and technical practicality, are relevant and appropriate to groundwater in Massachusetts. They set numeric limits for certain contaminants (e.g. arsenic, cadmium, copper, lead, manganese, mercury and non-numeric health-based standards for others (e.g. pathogenic organisms), as well as a pH range. The GWQSs are relevant and appropriate because they set standards for contaminant concentrations in groundwater. They are not applicable, because they technically only apply as criteria to be used in permitting discharges to groundwater. The groundwater beneath the site is Class I (fresh groundwater found in the saturated zone of unconsolidated deposits and is designated as a source of potable water supply). Table 2-4 lists the GWQSs.	This alternative will attain GWQSs.
Office of Research and Standards Guidelines ("ORSGs"), as found in Massachusetts Drinking Water Standards and Guidelines for Chemicals in Massachusetts Drinking Waters (May 1998)	TBC	The ORS has identified guidelines, based on health and technical practicality, applicable to drinking water. Table 2-4 lists the ORSGs. Because the ORSGs are not regulations, they are TBCs, rather than ARARs.	This alternative will attain ORSGs.
Human health Reference Doses (RfDs) and Cancer Slope Factors (CSFs) found in USEPA's IRIS database	TBC	USEPA requires the use of these values in the assessment of human health risk.	These values were used in the risk assessment and calculation of numerical remediation goals.
LOCATION-SPECIFIC ARARS			
Massachusetts Wetlands Protection Act and Regulations, M.G.L. c. 131, § 40; 310 CMR 10.00	Applicable	The Wetlands Protection Act (WPA) imposes requirements and limitations for alteration of land under water bodies and establishes performance standards for projects that affect wetlands. Because there are land under water bodies on the Site, these regulations are applicable.	The discharge of treated groundwater to Sinking Pond will be designed to comply with applicable provisions of the WPA and regulations.

Table C-1. ARARs and TBCs for Groundwater Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Massachusetts Wellhead Protection Regulations, 310 CMR 22.21	Applicable	301 CMR 22 requires that protective zones around a wellhead be established that limit activities and land uses (such as storage of chemicals and removal of soil) in the zones. Because the Assabet and School Street wellfields are within the Site, and because the Assabet 1 and 2, Christofferson, Scribner, and Lawsbrook wells have DEP-approved Zone II wellhead protection areas which overlap with the site, these requirements are applicable.	Alternative GW-3 will be designed to comply with 301 CMR 22.
ACTION SPECIFIC ARARS			
Clean Water Act (CWA) § 402 (33 U.S.C. §1342	Relevant and Appropriate	Section 402 of the CWA requires issuance of an NPDES permit prior to discharge of any pollutant to a water of the United States. Permits can only be issued in compliance with applicable technology standards.	The discharge for Alternative GW-3 will be designed to meet relevant and appropriate substantive standards under NPDES regulations.
Clean Water Act (CWA) § 304(a) (33 U.S.C. §1314(a))	Relevant and Appropriate	Federal National Recommended Water Quality Criteria (NRWQC) include (1) human health-based criteria and (2) other water quality parameters protective of fish and aquatic life. NRWQC for the protection of human health provide levels for exposure from drinking water and consuming aquatic organisms, and from consuming fish alone. Discharges subject to NPDES permitting requirements must not result in exceedances of NRWQCs. Table 2-5 lists the NRWQC.	The discharge to Sinking Pond will not cause or contribute to an exceedance of NRWQC.
Resource Conservation and Recovery Act (RCRA, 42 USC 6901-6992) - Groundwater Protection; 40 CFR Part 264, Subpart F.	Relevant and Appropriate	These regulations establish acceptable concentrations of hazardous constituents in the groundwater at licensed RCRA hazardous waste facilities. The point of compliance is set at the edge of the waste management unit(s). The regulations also establish groundwater monitoring requirements.	The groundwater monitoring provisions of Subpart F will be used to develop a long-term monitoring plan for the Site.

Table C-1. ARARs and TBCs for Groundwater Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
RCRA - Identification and Listing of Hazardous Wastes; 40 CFR Part 261	Relevant and Appropriate	Part 261 establishes requirements for determining whether wastes are hazardous.	These regulations will be used to determine whether any wastewater treatment residuals are hazardous waste.
RCRA Generator Requirements; 40 CFR Part 262	Relevant and Appropriate	RCRA establishes requirements applicable to generators of hazardous waste. Those requirements include provisions addressing hazardous waste determinations, manifesting, pre-transport requirements, and recordkeeping.	Wastewater treatment residuals that are determined to be hazardous waste will be handled in compliance with these regulations.
Massachusetts Air Pollution Control Regulations, 310 CMR 7.00	Applicable	These regulations set requirements on the control of fugitive emissions and dust.	These requirements will be met during construction activities.
Massachusetts Clean Water Act; G.L. ch. 21, § 26-51; 314 CMR 3.00	Applicable	The Massachusetts Clean Water Act and regulations impose requirements for permits prior to discharges to waters of the Commonwealth.	This alternative will be designed and operated in compliance with the MCWA and 314 CMR 3.00.
Massachusetts Clean Water Act, G.L. ch. 21, § 26-51; 314 CMR 3.00.	Applicable	The Massachusetts regulations provide that discharges to waters of the Commonwealth shall not result in exceedances of Massachusetts Surface Water Quality Standards. These standards are the same as the NRWQCs for the compounds analyzed for at the Site (see Table 2-5).	The discharge to Sinking Pond will be designed and operated so that it will not cause or contribute to an exceedance of the MSWQS.
Massachusetts Hazardous Waste Rules for Identification and Listing of Hazardous Waste; 310 CMR 30.100.	Applicable	310 CMR 30.100 establishes requirements for determining whether wastes are hazardous.	These regulations will be used to determine whether any wastewater treatment residuals are hazardous waste.

APPENDIX C – APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
Safe Drinking Water Act, Underground Injection Control Requirements, 40 CFR Part 144	Applicable	The Underground Injection Control program regulations promulgated under Part C of the Safe Drinking Water Act (SDWA) establish requirements for underground injection of treated groundwater.	These requirements wells will be met if treated water is re-injected as part of this Alternative.
Massachusetts Hazardous Waste Rules for Generators of Hazardous Waste; 310 CMR 30.300.	Applicable	310 CMR 30.300 establishes requirements applicable to generators of hazardous waste. Those requirements include provisions addressing hazardous waste determinations, manifesting, pre-transport requirements, and recordkeeping.	Wastewater treatment residuals that are determined to be hazardous waste will be handled in compliance with these regulations.

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
Massachusetts Rules for Remedial Air Emissions, 310 CMR 40.0049	Relevant and Appropriate	The Massachusetts rules set forth standards for emissions from remedial activities, including a general requirement for 95% control over emissions from the remedial system.	This alternative will be designed and operated in compliance with these requirements
Massachusetts Threshold Exposure Limits (TELs) and Allowable Ambient Limits (AALs) for Ambient Air	TBC	DEP has issued guidance setting out permissible concentrations of air toxics in ambient air. The TELs and AALs are used to guide permitting decisions for sources of air toxics. Table 2-6 lists the TELs and AALs for compounds analyzed for at the Site.	This alternative will be designed and operated so that remedial air emissions do not cause any exceedances of TELs or AALs.
Massachusetts Wetlands Protection Act and Regulations, M.G.L. c. 131, § 40; 310 CMR 10.00	Applicable	The Wetlands Protection Act Imposes requirements and limitations for alteration of wetlands. It establishes performance standards for projects that affect wetlands. Because there are wetlands on the Site, these regulations are applicable.	The discharge of treated groundwater to Sinking Pond will be designed to comply with applicable provisions of the WPA and regulations.
Policy on Control of Air Emissions Superfund Sites OSWER Directive 9355.0-28	TBC	Provides EPA Policy regarding control of emissions from air strippers used during cleanup at Superfund Sites.	This policy will be considered in the design and operation of the air stripper.

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
USEPA Region 1 Memo Lois Gitto to Merrill Hohman, July 12, 1989	TBC	Lays out Regional policy on emissions from air strippers at Superfund Sites.	This policy will be considered in the design and operation of the air stripper.
Massachusetts Well Decommissioning Requirements, 313 CMR 3.03.	Applicable	Massachusetts regulations provide for certain notification requirements upon well abandonment.	The Massachusetts regulations will be followed to the extent that the alternative involves decommissioning any wells.

Table C-2: ARARs and TBCs for Sinking Pond Sediment Remediation

Statute/Regulation	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
Chemical Specific ARARs			
Consensus-Based Sediment Quality Guidelines; MADEP, 2002. Technical Update, Freshwater Sediment Screening Benchmarks for Use Under the Massachusetts Contingency Plan.	TBC	MADEP recommends using the MacDonald et al. (2000) screening values for evaluating freshwater sediment and risks to benthic organisms. MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39, 20-31.	These guidelines were considered in the risk assessments and in developing risk-based remedial goals for sediment.
Ontario Provincial Sediment Quality Guideline	TBC	The Ontario Provincial Lowest Effect Levels (LEL) are used to identify sediment at which most benthic organisms are unaffected. (Ontario Ministry of the Environment, 1993a and b, 1994). Ontario Ministry of the Environment and Energy, 1993a. *Development of the Ontario Provincial Sediment Quality Guidelines for PCBs and the Organochlorine Pesticides*, Water Resources Branch. Ontario Ministry of the Environment and Energy, 1993b. *Development of the Ontario Provincial Sediment Quality Guidelines for Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, and Zinc*, Water Resources Branch. Ontario Ministry of the Environment and Energy, 1994. Development of the Ontario Provincial Sediment Quality Guidelines for Polycyclic Aromatic Hydrocarbons (PAH), Water Resources Branch.	These guidelines were considered in the risk assessments and in developing risk-based remedial goals for sediment.

Table C-2: ARARs and TBCs for Sinking Pond Sediment Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
LOCATION-SPECIFIC ARARs			
Massachusetts Wetlands Protection Act and Regulations, M.G.L. c. 131, § 40; 310 CMR 10.00	Applicable	The Wetlands Protection Act (WPA) imposes requirements and limitations for alteration of areas subject to protection under the WPA, including land under water bodies and establishes performance standards for projects that affect land under water bodies. Because Sinking Pond contains areas subject to jurisdiction under the WPA, these regulations are applicable.	It should be feasible to design this Alternative to be consistent with the performance standards in the Wetlands Protection Act Regulations.
Bordering Vegetated Wetland Delineation Criteria and Methodology, Issued: March 1, 1995	TBC	This policy defines which plant species or other plants are wetland indicator plants as specified in the wetland regulations (310 CMR 10.55(2)(c)). This policy also identifies a standard methodology for determining the boundary of Bordering Vegetated Wetlands (BVWs) in accordance with 310 CMR 10.55(2)(c)(1-3).	These Alternatives can be implemented in compliance with this Policy.
ACTION SPECIFIC ARARS			
RCRA - Identification and Listing of Hazardous Wastes; 40 CFR Part 261	Relevant and Appropriate	Part 261 establishes requirements for determining whether wastes are hazardous.	This alternative can easily be implemented to comply with the Part 261 regulations in determining whether any excavated sediments are hazardous waste.
RCRA Generator Requirements; 40 CFR Part 262	Relevant and Appropriate	RCRA establishes requirements applicable to generators of hazardous waste. Those requirements include provisions addressing hazardous waste determinations, manifesting, pre-transport requirements, and recordkeeping.	This Alternative can easily be the Part 262 regulations 310 CMR 30.300 if in fact any excavated sediments are hazardous waste.

Table C-2: ARARs and TBCs for Sinking Pond Sediment Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
Massachusetts Hazardous Waste Rules for Identification and Listing of Hazardous Waste; 310 CMR 30.100.	Applicable	310 CMR 30.100 establishes requirements for determining whether wastes are hazardous.	This Alternative can easily be implemented to comply with 310 CMR 30.100 in determining whether any excavated sediments are hazardous waste.
Massachusetts Hazardous Waste Rules for Generators of Hazardous Waste; 310 CMR 30.300.	Applicable	310 CMR 30.300 establishes requirements applicable to generators of hazardous waste. Those requirements include provisions addressing hazardous waste determinations, manifesting, pre-transport requirements, and recordkeeping.	This Alternative can easily be implemented to comply with 310 CMR 30.300 if in fact any excavated sediments are hazardous waste.
Massachusetts Wetlands Protection Act and Regulations, M.G.L. c. 131, § 40; 310 CMR 10.00	Applicable	The Wetlands Protection Act (WPA) imposes requirements and limitations for alteration of areas subject to protection under the WPA, including land under water bodies and establishes performance standards for projects that affect land under water bodies. Because Sinking Pond contains areas subject to jurisdiction under the WPA, these regulations are applicable.	It should be feasible to design this Alternative to be consistent with the performance standards in the Wetlands Protection Act Regulations.
Massachusetts Solid Waste Management Regulations (310 CMR 19.00)	Applicable	These regulations address non-hazardous waste and closure, post closure and maintenance of solid waste landfills. If non-hazardous wastes are left on site as part of this Alternative, the disposal Closure/Post Closure Standards would be met.	If non-hazardous wastes are left on-site, this Alternative will meet the closure/post closure standards to prevent human contact and migration of contaminants to surface and groundwater.

Table C-3: ARARs and TBCs for North Lagoon Wetland Sediment Remediation

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
CHEMICAL SPECIFIC ARARs			
Consensus-Based Sediment Quality Guidelines; MADEP, 2002. Technical Update, Freshwater Sediment Screening Benchmarks for Use Under the Massachusetts Contingency Plan.	TBC	MADEP recommends using the MacDonald et al. (2000) screening values for evaluating freshwater sediment and risks to benthic organisms. MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39, 20-31.	These guidelines were considered in the risk assessments and in developing risk-based remedial goals for sediment.
Ontario Provincial Sediment Quality Guideline	TBC	The Ontario Provincial Lowest Effect Levels (LEL) are used to identify sediment at which most benthic organisms are unaffected. (Ontario Ministry of the Environment, 1993a and b, 1994). Ontario Ministry of the Environment and Energy, 1993a. *Development of the Ontario Provincial Sediment Quality Guidelines for PCBs and the Organochlorine Pesticides,* Water Resources Branch. Ontario Ministry of the Environment and Energy, 1993b. *Development of the Ontario Provincial Sediment Quality Guidelines for Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, and Zinc*, Water Resources Branch. Ontario Ministry of the Environment and Energy, 1994. Development of the Ontario Provincial Sediment Quality Guidelines for Polycyclic Aromatic Hydrocarbons (PAH), Water Resources Branch.	These guidelines were considered in the risk assessments and in developing risk-based remedial goals for sediment.

Table C-3: ARARs and TBCs for North Lagoon Wetland Sediment Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
LOCATION-SPECIFIC ARARS			
Protection of Wetlands Executive Order No. 11990 (May 24, 1977), 42 Fed. Reg. 26961, 18 C.F.R. § 725.	Applicable	The Executive Order (EO) imposes requirements on federal agencies that oversee projects undertaken in wetlands areas, including natural ponds. It requires federal agencies to avoid construction in wetlands unless there is no practicable alternative to such construction. If there is no practical alternative to conducting work in the wetlands all practicable measures to minimize harm to wetlands from such construction must be taken. The North Lagoon Wetland is a jurisdictional wetland area. Because there are wetlands on the Site and a federal agency is overseeing the remediation, this requirement is applicable.	Because the contamination that will be remediated is located in wetlands, there is no practical alternative to address this contamination. Measures will be taken to minimize impacts.
Massachusetts Wetlands Protection Act and Regulations, M.G.L. c. 131, § 40; 310 CMR 10.00	Applicable	The Wetlands Protection Act (WPA) imposes requirements and limitations for alteration of wetlands and establishes performance standards for projects that affect wetlands. Because the North Lagoon Wetland contains areas subject to jurisdiction under the WPA, these regulations are applicable.	This alternative will be conducted in accordance with these regulations.

Table C-3: ARARs and TBCs for North Lagoon Wetland Sediment Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
Floodplain Management Executive Order No. 11988 (May 24, 1977), 42 Fed. Reg. 26951, 18 C.F.R. § 725.	Applicable	The Executive Order (EO) imposes requirements on federal agencies that oversee projects undertaken in floodplains. It requires federal agencies to avoid activities in floodplains unless there is no practicable alternative to such activities. If there is no practical alternative to conducting work in the floodplain, all practicable measures to minimize impacts must be taken. Because there is a floodplain on the Site and a federal agency is involved with the remediation, this requirement is applicable	Because some of the contamination in the North Lagoon Wetland that presents an unacceptable risk is located in a floodplain, there is no practical alternative to address this contamination. Measures will be taken to minimize impacts.
Bordering Vegetated Wetland Delineation Criteria and Methodology, Issued: March 1, 1995	TBC	This policy defines which plant species or other plants are wetland indicator plants as specified in the wetland regulations (310 CMR 10.55(2)(c)). This policy also identifies a standard methodology for determining the boundary of Bordering Vegetated Wetlands (BVWs) in accordance with 310 CMR 10.55(2)(c)(1-3).	This guidance will be used to define the boundary of the wetlands for state wetland purposes.
ACTION SPECIFIC ARARS			
RCRA - Identification and Listing of Hazardous Wastes; 40 CFR Part 261	Relevant and Appropriate	Part 261 establishes requirements for determining whether wastes are hazardous.	These regulations will be used to determine whether excavated sediments should be managed as hazardous waste.
RCRA Generator Requirements; 40 CFR Part 262	Relevant and Appropriate	RCRA establishes requirements applicable to generators of hazardous waste. Those requirements include provisions addressing hazardous waste determinations, manifesting, pre-transport requirements, and recordkeeping.	Sediment that is determined to be hazardous waste will be handled in compliance with these regulations.

Table C-3: ARARs and TBCs for North Lagoon Wetland Sediment Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARs
Clean Water Act (CWA) § 402 (33 U.S.C. § 1342	Applicable	Section 402 of the CWA requires issuance of an NPDES permit prior to discharge of any pollutant to a water of the United States. Permits can only be issued in compliance with applicable technology standards.	To the extent that this Alternative requires dewatering of contaminated sediments, the discharge from the dewatering operations will be designed to meet applicable substantive standards under NPDES regulations.
Clean Water Act (CWA) § 304(a) (33 U.S.C. § 1314(a))	Applicable	Federal National Recommended Water Quality Criteria (NRWQC) include (1) human health-based criteria and (2) other water quality parameters protective of fish and aquatic life. NRWQC for the protection of human health provide levels for exposure from drinking water and consuming aquatic organisms, and from consuming fish alone. Discharges subject to NPDES permitting requirements must not result in exceedances of NRWQCs. Table 2-5 lists the NRWQC.	To the extent that this Alternative requires dewatering of contaminated sediments, the discharge from the dewatering operations will be designed and operated so that it will not cause or contribute to an exceedance of the NRWQC.
Massachusetts Clean Water Act, G.L. ch. 21, § 26-51; 314 CMR 3.00.	Applicable	The Massachusetts regulations provide that discharges to waters of the Commonwealth shall not result in exceedances of Massachusetts Surface Water Quality Standards. These standards are the same as the NRWQCs for the compounds analyzed for at the Site (see Table 2-5).	To the extent that this Alternative requires dewatering of contaminated sediments, the discharge from the dewatering operations will be designed and operated so that it will not cause or contribute to an exceedance of the MSWQS.
Massachusetts Hazardous Waste Rules for Identification and Listing of Hazardous Waste; 310 CMR 30.100.	Applicable	310 CMR 30.100 establishes requirements for determining whether wastes are hazardous.	These regulations will be used to determine whether excavated sediments should be managed as hazardous waste.

Table C-3: ARARs and TBCs for North Lagoon Wetland Sediment Remediation (CONTINUED)

STATUTE/REGULATION	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
Massachusetts Hazardous Waste Rules for Generators of Hazardous Waste; 310 CMR 30.300.	Applicable	310 CMR 30.300 establishes requirements applicable to generators of hazardous waste. Those requirements include provisions addressing hazardous waste determinations, manifesting, pre-transport requirements, and recordkeeping.	Sediment that is determined to be hazardous waste will be handled in compliance with these regulations.
Massachusetts Air Pollution Control Regulations, 310 CMR 7.00	Applicable	These regulations set requirements on the control of fugitive emissions and dust.	These requirements will be met during construction activities.
Massachusetts Solid Waste Management Regulations (310 CMR 19.00)	Applicable	These regulations address non-hazardous waste and closure, post closure and maintenance of solid waste landfills. If non-hazardous wastes are left on site as part of this Alternative, the disposal Closure/Post Closure Standards would be met.	If non-hazardous wastes are left on-site, this Alternative will meet the closure/post closure standards to prevent human contact and migration of contaminants to surface and groundwater.

Attachment 2

ARARs Evaluation

Industriplex Superfund Site
Woburn, Massachusetts

TABLE 2-1
POTENTIAL CHEMICAL-SPECIFIC ARARs
DRAFT FINAL MSGRP FEASIBILITY STUDY
INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
Federal Regulatory Requirements	National Pollution Discharge Elimination System (NPDES) (40 CFR 122)	Potentially Applicable	Regulates the discharge of water into public surface waters. Major requirements include the following: • Use of best available technology economically achievable is required to control toxic and non-conventional pollutants. Use of best conventional pollutant control technology is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis. • Applicable federally-approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	Any alternative that involves discharges to surface waters may need to include treatment to comply with NPDES. Massachusetts' federally-approved NPDES permit program is outlined in 314 CMR 3.00.
	National Recommended Water Quality Criteria [Clean Water Act-Section 304(a)(1)]	Relevant and Appropriate	Provides surface water quality standards for a number of organic and inorganic contaminants.	NAWQC may be used in determining PRGs for surface water.
	Massachusetts Surface Water Quality Standards (314 CMR 4.00)	Potentially Applicable	These standards designate the most sensitive uses for which the various waters of the Commonwealth shall be enhanced, maintained, or protected. Minimum water quality criteria required to sustain the designated uses are established. Federal AWQC are to be considered in determining effluent discharge limits. Where recommended limits are not available, site-specific limits shall be developed.	Discharges of water (in the form of dewatering effluent, groundwater treatment system effluent, etc.) to surface water bodies will be governed by this regulation.
	Massachusetts Ground Water Discharge Permit Program (314 CMR 5.00)	Potentially Applicable	Groundwater discharges shall not result in a violation of Massachusetts Surface Water Quality Standards (314 CMR 4.00) or Massachusetts Ground Water Quality Standards (314 CMR 6.00).	Remedial alternatives that include groundwater discharge will need to comply with this regulation.

TABLE 2-1 (cont.)
POTENTIAL CHEMICAL-SPECIFIC ARARs
DRAFT FINAL MSGRP FEASIBILITY STUDY
INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
State Regulatory Requirements	Massachusetts Groundwater Quality Standards (314 CMR 6.00)	Applicable	These standards designate and assign uses for which groundwater in the Commonwealth shall be managed and protected, and set forth water quality criteria necessary to maintain the designated areas.	GW-3 and GW-1 standards apply to the site. These classifications will dictate the remedial goals that must be met for groundwater.
	Massachusetts Contingency Plan, Method 1 Groundwater Standards, 310 CMR 40.0974(2)	Relevant and Appropriate	The MCP has established a set of risk-based threshold concentrations that must be attained in order to achieve a condition of no significant risk for groundwater within a particular groundwater classification area.	Method 1 standards will be considered during the development of PRGs for groundwater and soils.
	Massachusetts Ambient Air Quality Standards (310 CMR 6.0) and Massachusetts Air Pollution Control Regulations (310 CMR 7.00)	Potentially Applicable	The applicable portions of this regulation establish requirements for the design and construction of Contaminated Groundwater Treatment Systems (CGTS) within the Commonwealth of Massachusetts. These include instrumentation requirements and record keeping requirements to ensure compliance with the emission standards. This regulation also contains standards for fugitive emissions, dust, and particulates during construction.	Any groundwater treatment system that includes point-source air emissions as part of the treatment process would need to comply with these requirements. Remedial actions that involve excavation of any type must be designed to minimize fugitive emissions of any type.
Criteria, Advisories, and Guidance	Cancer Slope Factors (CSFs)	To Be Considered	Guidance values used to evaluate the potential carcinogenic risk caused by exposure to contaminants.	CSFs were used to evaluate health risks associated with site-related contaminants, and will be used in the derivation of PRGs for the FS.
	Reference Doses (RfDs)	To Be Considered	Guidance values used to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	RFDs were used to evaluate health risks associated with site-related contaminants, and will be used in the derivation of PRGs for the FS.
	EPA Health Advisories, Human Health Risk Assessment Guidance, and Ecological Risk Assessment Guidance	To Be Considered	These advisories and guidance documents provide guidance for developing health risk information and environmental assessments at Superfund sites.	These advisories and guidance documents may be used in the derivation of PRGs for the FS.

TABLE 2-2
POTENTIAL LOCATION-SPECIFIC ARARs AND TBCs
DRAFT FINAL MSGRP FEASIBILITY STUDY
INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
Federal Regulatory Requirements	Statement of Procedures on Wetlands Protection, 40 CFR Part 6, App. A, Exec. Order 11990 (1977) 40 CFR 6.302(a)	Potentially Applicable	Federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and the Order emphasizes the importance of avoiding new construction or harm to wetlands unless there is no practicable alternative to such construction.	Any alternative that includes activities within wetland areas that might result in the destruction, loss, or degradation of wetlands will need to comply with this order.
	Executive Order for Floodplain Management Exec Order 11988 (1977) 40 CFR Part 6, App. A. 40 CFR 6.302(b)	Potentially Applicable	Federal agencies are required to avoid impacts associated with the occupancy and modification of a floodplain and avoid support of floodplain development wherever there is a practicable alternative.	Any alternative that includes activities within floodplain areas that might result in the occupancy or modification of the floodplain will need to comply with this order.
	RCRA Floodplain Restrictions for Solid Waste Disposal Facilities and Practices (40 CFR 257.3-1)	Relevant and Appropriate	Solid waste practices must not restrict the flow of a 100-year flood, reduce the temporary water storage capacity of the floodplain or result in washout of solid waste, so as to pose a hazard to human life, wildlife, or land or water resources.	Alternatives whose implementation may impact the flood storage capacity of the areas adjacent to surface water bodies will be designed, to the extent practicable, to avoid impacts that would violate this regulation.
	RCRA Floodplain Restrictions for Hazardous Waste Facilities (40 CFR 264.18(b))	Relevant and Appropriate	A hazardous waste treatment, storage, or disposal facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.	Alternatives that might impact floodplains through washout or accidental transport of contaminated media into floodplain areas will be designed to prevent such events from occurring.
	16 USC 661 et. Seq., Fish and Wildlife Coordination Act (50 CFR Parts 81, 226, 402)	Potentially Applicable	Federal agencies are required to consider the effect that water-related projects will have on fish and wildlife; and to consult with the state to develop measures to prevent, mitigate, or compensate for project-related losses of fish and wildlife.	Alternatives that involve actions that might impact fish and wildlife will require consultation with the Fish and Wildlife Service to develop appropriate measures to protect resources.

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
State Regulatory Requirements	Massachusetts Wetlands Protection Act and Regulations, (310 CMR 10.00)	Potentially Applicable	These regulations are promulgated under Wetlands Protection Laws, which regulate dredging, filling, altering, or polluting of wetlands. Work within 100 feet of a wetland is regulated under this requirement.	Any work conducted within wetlands will be subject to compliance with these regulations.
	Water Quality Certification for Discharge of Dredged or Fill Material, Dredging and Dredged Material Disposal in Waters of the United States within the Commonwealth, 314 CMR 9.06	Applicable	For discharge of dredged or fill material, there must be no practicable alternative with less adverse impact on aquatic ecosystem; must take practicable steps to minimize adverse impacts on wetlands or land under water; stormwater discharges must be controlled with BMPs; must be no substantial adverse impact to physical, chemical, or biological integrity of surface waters.	Alternatives that include dredging of sediment will require compliance with these regulations
	Water Quality Certification for Discharge of Dredged or Fill Material, Dredging and Dredged Material Disposal in Waters of the United States within the Commonwealth, 314 CMR 9.07	Applicable	Hydraulic or mechanical dredging allowed; must avoid fisheries impacts.	Alternatives that include dredging of sediment will require compliance with these regulations

TABLE 2-3
POTENTIAL ACTION-SPECIFIC ARARs
DRAFT FINAL MSGRP FEASIBILITY STUDY
INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
Federal Regulatory Requirements	Statement of Procedures on Wetlands Protection, 40 CFR Part 6, App. A, Exec. Order 11990 40 CFR 6.302(a)	Applicable	Federal agencies shall avoid, whenever possible, the long and short term impacts associated with the destruction of wetlands, and wetlands development wherever there is a practicable alternative in accordance with Executive Order 11990.	Any plans for actions within wetland areas must comply with this requirement, and practicable alternatives to the destruction of wetlands or occupancy/modification of floodplains must be explored.
	Executive Order for Floodplain Management Exec. Order 11988 40 CFR Part 6, App. A. 40 CFR 6.302(b)	Applicable	Federal agencies are required to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains.	Any plans for actions within floodplain areas must comply with this requirement, and practicable alternatives to the destruction of wetlands or occupancy/modification of floodplains must be explored.
	RCRA Identification and Listing of Hazardous Wastes, 40 CFR 261.3	Applicable or Relevant and Appropriate	Criteria for determining if a waste or contaminated media is a hazardous waste subject to regulation. If a contaminated media exhibits the characteristics of a hazardous waste, RCRA hazardous waste regulations are applicable. If a contaminated media is sufficiently similar to listed RCRA hazardous wastes, these regulations are relevant and appropriate.	Contaminated soils/sediments will be assessed using this criteria to determine whether they should be managed as hazardous waste.
	RCRA – Groundwater Monitoring (40 CFR 264, Subpart F)	Relevant and Appropriate	This regulation details the requirements for groundwater monitoring and responding to releases from solid waste management units.	Groundwater monitoring would required to evaluate the natural attenuation processes and contaminant migration.
	RCRA Closure and Post-Closure Requirements 40 CFR, Subpart G	Relevant and Appropriate	If contaminated soil constitutes characteristic hazardous waste or are sufficiently similar to listed RCRA hazardous wastes, these regulations are relevant and appropriate. Closure must be completed in a manner that minimizes the need for further maintenance, and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.	These regulations may be relevant and appropriate for soil alternatives if soil is sufficiently contaminated to warrant a hazardous classification.

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
Federal Regulatory Requirements (cont.)	Clean Water Act §404 and regulations, 33 USC 1344, 40 CFR 230	Potentially Applicable	No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the discharge which would have a less adverse impact to the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.	Permits must be acquired where activities are conducted within an aquatic environment. The permit application must show that appropriate and practicable steps have been taken to minimize the potential adverse impacts of the discharge on the aquatic ecosystem.
	RCRA Hazardous Waste Regulations (Storage and Disposal of Hazardous Waste) 40 CFR Part 262, Subpart A, 40 CFR Part 264, Subparts I and J	Applicable	Subpart A of Part 262 provides that a generator who treats, stores, or disposes of hazardous waste on-site must determine whether or not he has a hazardous waste, obtain an EPA identification number for any hazardous waste and comply with the regulations regarding accumulation of hazardous waste and recordkeeping. Subparts I and J of Part 264 identify design, operating, monitoring, closure, and post-closure care requirements for long-term storage of RCRA hazardous waste in containers and tank systems, respectively. However, Section 262.34(a) allows accumulation of RCRA hazardous wastes for up to 90 days in containers or tanks provided generator complies with requirements of Subparts I and J of Part 265.	Any free product, drums, or contaminated equipment will be managed and stored in accordance with the substantive requirements of the cited regulations prior to being sent off-site for disposal. Disposal regulations will also be complied with for any off-site disposal.
	Fish and Wildlife Coordination Act (16 USC 166 et. Seq)	Potentially Applicable	Any modification of a body of water requires prior consultation with the U.S. FWS to develop measures to prevent, mitigate, or compensate for losses to fish and wildlife.	Any alternative that involves modifications to water bodies must comply with this requirement.

TABLE 2-3 (cont.)
POTENTIAL ACTION-SPECIFIC ARARs
DRAFT FINAL MSGRP FEASIBILITY STUDY
INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS
PAGE 3 OF 4

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
Federal Regulatory Requirements (cont)	National Pollution Discharge Elimination System (NPDES) (40 CFR 122)	Potentially Applicable	Regulates the discharge of water into public surface waters. Major requirements include the following: • Use of best available technology economically achievable is required to control toxic and non-conventional pollutants. Use of best conventional pollutant control technology is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis. • Applicable federally-approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	Any alternative that involves discharge of water into surface water bodies (in the form of dewatering effluent, groundwater treatment system effluent, etc.) would need to comply with this requirement.
	National Recommended Water Quality Criteria Clean Water Act, Section 304(a)(1)	Relevant and Appropriate	Provides surface water quality standards for a number of organic and inorganic contaminants.	This regulation will be considered for any alternative that involves discharges to surface water bodies.
State Regulatory Requirements	Massachusetts Ambient Air Quality Standards (310 CMR 6.0) and Massachusetts Air Pollution Control Regulations (310 CMR 7.00)	Potentially Applicable	The applicable portions of this regulation establish requirements for the design and construction of Contaminated Groundwater Treatment Systems (CGTS) within the Commonwealth of Massachusetts. These include instrumentation requirements and record keeping requirements to ensure compliance with the emission standards. This regulation also contains standards for fugitive emissions, dust, and particulates during construction.	Any groundwater treatment system that includes point-source air emissions as part of the treatment process would need to comply with these requirements. Remedial actions that involve excavation of any type must be designed to minimize fugitive emissions of any type.
	Massachusetts Wetlands Protection Act and Regulations (310 CMR 10.00)	Potentially Applicable	This regulation defines the process through which local conservation commissions and MADEP may enforce state wetland regulations. The potentially applicable portions of this regulation include restrictions on activities that remove, fill, dredge, or alter wetlands or activities conducted within wetland buffer zones (within 100 feet of a wetland).	Any alternative that includes removal, fill, dredging, or alterations of wetland areas must comply with this regulation.

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR FEASIBILITY STUDY
State Regulatory Requirements (cont)	Massachusetts Surface Water Quality Standards (314 CMR 4.00)	Potentially Applicable	These standards designate the most sensitive uses for which the various waters of the Commonwealth shall be enhanced, maintained, or protected. Minimum water quality criteria required to sustain the designated uses are established. Federal AWQC are to be considered in determining effluent discharge limits. Where recommended limits are not available, site-specific limits shall be developed.	Discharges of water (in the form of dewatering effluent, groundwater treatment system effluent, etc.) to surface water bodies will be governed by this regulation.
	Water Quality Certification for Discharge of Dredged or Fill Material, Dredging and Dredged Material Disposal in Waters of the United States within the Commonwealth (314 CMR 9.06)	Potentially Applicable	The substantive portions of these regulations establish criteria and standards for the dredging, handling, and disposal of fill material and dredged material.	Remedial alternatives involving the dredging, handling, and disposal of material will need to comply with this regulation.
	Water Quality Certification for Discharge of Dredged or Fill Material, Dredging and Dredged Material Disposal in Waters of the United States within the Commonwealth (314 CMR 9.07)		The substantive portions of these regulations establish criteria and standards for the dredging, handling, and disposal of fill material and dredged material.	Remedial alternatives involving the dredging, handling, and disposal of material will need to comply with this regulation and impacts to fisheries in the area must be avoided.
	Massachusetts - Hazardous Waste Regulations (Storage and Disposal of Hazardous Waste), (310 CMR 30.300, 30.680, 30.690 and 310 CMR 30.340)	Potentially Applicable	Requirements for transport and long-term storage of RCRA hazardous waste in containers and tank systems	Remedial alternatives that include on-site storage or offsite transportation and disposal of contaminated material will need to comply with this regulation.

Memorandum

To: *Wilmington Environmental Restoration Committee*

From: *CDM Smith and Sanborn Head*

Date: *May 25, 2018*

Subject: *Review of Rock Matrix Sampling Work Plan*

CDM Smith and Sanborn Head have performed a review of the draft Rock Matrix Sampling Work Plan (Rock Matrix SWP). We write to provide comments on the work plan.

As a general overarching comment, the Rock Matrix SWP is an example of the type of studies that are conducted as part of an FS to determine the measures that can be implemented for source control and aquifer restoration. As proposed, the Rock Matrix SWP will not gather sufficient data to be meaningful, but an expanded scope may provide data and information useful to the FS.

General Thoughts

The approach detailed in the Rock Matrix Sampling Work Plan is designed to better understand contaminant mass flux in the bedrock. The approach is technically valid and will provide useful information. However, the testing appears to be aimed at proving that it is impractical to clean up the aquifer, rather than as a data gathering step aimed at better understanding the hydraulics and mass flux of the system with the goal of source control/removal. No rationale is provided for the selection of the location for the boring location, which is outside of the DAPL pool. In addition, it is not reasonable to expect that evaluation of the bedrock at one location will be sufficient to understand this complex system. How does mass flux within bedrock differ with rock type, weathering, extent of fracturing, proximity to DAPL?

Additional goals of the testing should include:

- Characterize the mass flux of NDMA within high transmissivity zones versus within low transmissivity zones
- Provide long-term water quality versus time data within various bedrock zones

Permanently installed FLUTe systems in multiple boreholes of the type proposed in the work plan could be used to monitor NDMA mass flux over time, in both high and low transmissivity zones, as DAPL sources are removed.

Comments:

- The report seems oriented toward making the case for a technical infeasibility (TI) waiver request. The discussion and background seem to suggest this conclusion prior to any data collection.
- Assuming a TI waiver as the goal, the general approach is possibly good. The Discrete Fracture Networks (DFN) approach referenced in the document was developed by University Consortium researchers (Parker/Cherry) and is an approach we have used successfully at a complex groundwater contamination site. Further, the FLUTe transmissivity profiling is also a very good technical approach if used correctly.
- Why was this work not conducted as part of the RI/FS? This work, if expanded in scope, could help to determine the extent/character of bedrock contamination with the goal of determining the amount of source control/reduction that is practical so that, even if it's not practical to restore the entire aquifer, it can be restored much faster through the combination of source control/removal and natural attenuation.
- The scope of the study as proposed is grossly inadequate. One borehole location is not sufficient to develop the level of understanding necessary at a site of this potential complexity. There are simply too many unknown variables, *e.g.*, age and size of fractures. Ideally, there would be multiple locations where they perform this type of characterization that are located within the source area, a moderate level plume location, and a downgradient "clean" location. Further, and maybe most importantly, the extent of contamination, both horizontally and vertically, is not at present adequately defined to support a TI waiver approach.
- Collecting data directly beneath the DAPL pool, and not beside it, is a better place to start. If there is matrix contamination a better approach might be to work outward and delineate the volume of rock with matrix contamination. Then a remedial measure to address this source, *i.e.*, matrix contamination, could be better focused. This would very much apply if the NDMA could be remediated with a thermal technology.
- The proposed study seems overly focused on the low transmissivity zones for their groundwater sampling with the Flute system, as sampling in locations within low and high transmissivity are equally important. At a very basic level, understanding contaminant mass flux from high and low permeability zones is a critical component to assessing the viability of remediation. There are other characterization techniques available that could supplement the assessment, but the proposed approach could yield valuable data if more locations are investigated.

- While there is no mention of how the data will be assessed, based on what they are proposing, they will likely supplement the data with modelling (probably using UC methods) to predict contaminant transport and fate. Models can be useful, but one location is not sufficient upon which to build a defensible model. A trust but verify approach is appropriate here.

- The proposed approach also lacks sufficient detail. We cannot tell from this document exactly what data will be collected or assessed. Will pore-water concentrations be estimated? Other data that could potentially be collected include:

  - Wet and dry Bulk density
  - Water content
  - Specific gravity
  - Porosity
  - Total organic carbon

- An effort should be made to analyze rock both at the fracture surfaces and from intervening unfractured matrix. This approach can provide very useful information, but we cannot tell if a similar approach is proposed here.

- Although we did not conduct a comprehensive review, there are a few specific points we have questions about.

  - What is the purpose of spiking each sample with labeled isotope standard NDMA-D6?
  - Will the geophysical logging include at least the parameters shown in Figure 2? Temperature and fluid conductivity would also be very important to collect (this may be mentioned in Addendum IV to the work plan, which is cited, but we cannot locate).
  - The geophysical log in Figure 2 does not seem to provide a good example of dominant and weak fractures, though admittedly we only see a limited section of the borehole. The heat pulse flow meter values hardly change across the fracture at 78 feet which they describe as “dominant”. There is a larger change (but still not much) across the fractures between 91 feet and 112 feet (in the pumping HPFM data) which is ignored.

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PROJECT MEMORANDUM

To: Jim DiLorenzo, Environmental Protection Agency — Date: May 30, 2018

From: Kevin Trainer
Joel Trifilo
Michael Webster — GeoInsight Project 5611-003

Cc: Jeffrey Hull, Wilmington Town Manager

Re: Results of Containment Area Bedrock Borings
Olin Chemical Superfund Site (OCSS)
51 Eames Street
Wilmington, Massachusetts

GeoInsight, Inc. (GeoInsight) prepared this memorandum to provide preliminary comments on the Results of Containment Area Bedrock Borings (the report) dated May 10, 2018, that was prepared by Wood Environment & Infrastructure Solutions (Wood) for the Olin Chemical Superfund Site (OCSS) in Wilmington, Massachusetts. Because we were provided limited time to review the document, our comments are preliminary and focused on strategic project considerations.

Based upon our preliminary review of the report, we have the following observations:

1. The locations of the borings are insufficient to adequately characterize potential fractures that may be present in the containment area. The report indicated that boring OC-BB-2-2018 "...was positioned along the geologic strike of competent bedrock lithology encountered in GW-202BR." Investigating along an area of presumed competent bedrock is not an objective evaluation of the potential fractures that may be present. The Containment Area is located in an elongated bedrock "valley" that is oriented approximately northeast to southwest. The orientation of this feature generally coincides with the dominant strike of features identified during the geophysical logging, which suggests that this valley may be formed in a zone of bedrock fractures. Therefore, bedrock investigation should be conducted along the strike of the observed features (i.e., to the northeast and southwest of the Containment Area), and not in the areas that were investigated.

2. The report suggests that bedrock is competent, but does not present the information that fractured, incompetent, shallow bedrock was encountered in both borings. Bedrock was encountered at 27 feet in OC-BB-1-2018; however, auger advancement was able to continue for two feet through weathered bedrock. Several water-bearing fractures were noted between 27 and 41 feet below the ground surface (bgs), where the casing was installed. These data clearly indicate approximately 14 feet of weathered, incompetent bedrock at this location.

3. Auger refusal was encountered at 17 feet bgs in OC-BB-2-2018; however, the boring logs indicated fractured rock to at least 27 feet bgs. Subsequent drilling into supposed competent rock resulted in six feet of cave-in within the boring when the drilling tools reached 30 feet bgs. The casing appears to be set at 28 feet (i.e., within the cave-in material). Subsequent drilling notes indicate "borehole making water," indicating that groundwater is entering either through bedrock fractures (although this was not identified in the borehole geophysical logging) or from fractured bedrock above the grouted well casing. These data also clearly indicate that approximately 13 feet of shallow bedrock at this location is fractured and incompetent between 17 feet and at least 30 feet bgs.

4. The fractures identified by the geophysical logging are mostly subvertical (with dip angles between 50 and 80 degrees). Therefore, vertical borings are not ideally oriented to evaluate the potential fractures. Many borings (more than just the two completed borings) would be required to properly evaluate the potential fractures present in the Containment Area. Due to the subvertical nature of fractures, it is not justifiable to have a high degree of confidence about bedrock competency using data from only two borings.

5. The report states "...the observed fractures are well below the bottom of the DAPL in the Containment Area..." However, the water-bearing fracture that was identified in boring OC-BB-1-2018 (feature number 102, observed at a depth of 176 feet bgs) has a reported strike on an azimuth of 216 degrees (true) and a dip of 66 degrees to the northwest. Extrapolation of this fracture using the provided strike and dip data to the top of the bedrock surface (approximately 27 feet bgs) indicates that this fracture would be located approximately 66 feet to the southeast, <u>which is within the DAPL pool boundary</u>. Additional investigation should be conducted to:

    - characterize water quality within this fracture for DAPL constituents;
    - evaluate if this observed water-bearing fracture in OC-BB-1-2018 continues to extend into the DAPL pool area; and
    - whether this fracture intersects other fractures at shallower depths, and (if present) whether DAPL constituents are present in these fractures.

6. During the hydraulic pulse interference test (HPIT) study conducted to evaluate the integrity of the slurry well, a hydraulic pulse was received during the GW-6D to GW-CA3D test. In their data review, Amec suggested that the pulse could have been transmitted under the slurry wall through weathered bedrock. GeoInsight did not agree with this unfounded assertion based upon the data provided. However, Olin now appears to suggest that the bedrock in the containment cell is competent, which contradicts their

earlier assertion from the HPIT test review. Simply put, Olin cannot have it both ways. If Olin now wishes to assert that the bedrock beneath the containment area is competent, then the HPIT testing indicates a failure in the slurry wall that requires additional evaluation. We note that for practical purposes, there is no point in distinguishing between "weathered bedrock" and "underlying bedrock" because the slurry wall was installed to the top of bedrock – not completely through the weathered bedrock zone. Ignoring the weathered bedrock zone, as Olin does in their investigation, results in an incomplete understanding of the integrity of the Containment Area.

7. The report states "...the fracture network, to the extent it exists, is not well connected." The parenthetical statement ("to the extent it exists") is unnecessary and misleading, falsely suggesting that a fracture network may not be present in these locations. Multiple fractures have been identified in these, and nearby bedrock borings. In addition, there is also no data to indicate that the fractures are not well connected. Olin did not complete testing of borehole or fracture connectivity to evaluate potential groundwater flow and connections in the bedrock fractures. Using the existing data to justify a conclusion that the fractures are not well-connected is unfounded.

8. The report states that the bedrock is "...a siliceous competent bedrock (mapped as a quartzite)..." but the United States Geologic Survey identifies the bedrock in this area as metamorphic mafic to felsic flow, volcaniclastic, and hypabyssal intrusive rocks frequently containing diorite and gabbro. Previous field investigations identified diorite and gabbro as the primary rock type (not quartzite). The report also states "The rock comprises a light to dark grey fine grain quartz rich matrix with abundant veins of white quartz parallel to foliation." We note that quartz is frequently a translucent grey color and quartz is generally rare when gabbro and diorite are present. Opaque white minerals are typically consistent with feldspar, not quartz. The optical televiewer logs also show a degree of foliation that is not characteristic of quartzite. Based on the rock description, the mapped geology of the area, the optical televiewer logs, and the previous investigations, it is likely that the bedrock is not quartzite.

GeoInsight®
Environmental Strategy & Engineering

May 25, 2018 GeoInsight Project 5611-001

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United States Environmental Protection Agency
Office of Site Remediation and Restoration
One Congress Street, Suite 1100-HBO
Boston, MA 02114-2023

RE: Comments on RI/FS and Baseline Human Health Risk Assessment
Olin Chemical Superfund Site
Wilmington, Massachusetts

Dear Mr. DiLorenzo:

GeoInsight, Inc. (GeoInsight) prepared this letter at the request of the Town of Wilmington (the Town) for the Olin Chemical Superfund Site (OCSS). In this letter GeoInsight provides comments to the following four documents.

On April 9, 2018, the United States Environmental Protection Agency's (USEPA) forwarded to GeoInsight, Inc. (GeoInsight) the following four documents prepared by Amec Foster Wheeler Environment & Infrastructure (Amec), Inc. on behalf of Olin Corporation:

- Draft Operable Unit 1 and Operable Unit 2 Feasibility Study (FS) – dated March 30, 2018;
- Draft Remedial Investigation Report Operable Unit 3 – dated March 30, 2018;
- Draft Operable Unit 3 Feasibility Study – dated March 30, 2018; and
- Draft Baseline Human Health Risk Assessment (BHHRA) Operable Unit 3 – dated March 2018.

The Operable Units at the OCSS are identified as follows:

OU1: the approximately 50-acre Olin Property including the former facility area, the established conservation area, the on-Property ditch system, the Calcium Sulfate Landfill, and the Slurry Wall Containment Area. The RI/FS evaluates soil, surface water, sediment and potential vapor intrusion into existing OU1 buildings. It should be noted that soils located within the water table at the Olin Property were evaluated under OU3.

OU2: off-Property surface water and sediment areas, including the off- Property East Ditch, a small portion of the South Ditch, the off-Property West Ditch (off-PWD), portions of the Maple Meadow Brook Wetland, and the North Pond. Landfill Brook was investigated as part of OU2 and was found to be impacted by the Woburn Sanitary Landfill (WSL) rather than the OCSS.

OU3: all on- and off-Property groundwater areas including Maple Meadow Brook Aquifer, groundwater beneath the Olin Property, and groundwater located south and east of the Olin Property. Saturated zone soil located below the water table are also included under OU3.

Because of the imposed time limitation to complete the review of the OCSS RI/FS documents, GeoInsight focused our review on "bigger picture" considerations. The following comments prepared by GeoInsight, were based upon a preliminary review of the aforementioned documents, reviews of previous comment letters prepared by GeoInsight, and a meeting with USEPA, the Town, and other stakeholders on May 8, 2018. The comments are provided in no particular order, some of which were presented previously and some of which, have also been identified by USEPA and Nobis.

General Observation

In our review of these documents, a recurring concern is that Olin makes statements that are technically unsupported or are supported by an extremely limited amount of data or observations. These statements are then presumed by Olin to be factual and are used in subsequent data interpretations or decision-making procedures, even when there is insufficient justification for this application.

We also note that some of Olin's data collection efforts appear to be focused upon supporting specific technical or regulatory positions, rather than objectively evaluating site conditions or potential response actions. The recent unsolicited investigations and modeling for potential matrix diffusion were apparently initiated to support a position that remediation is technically infeasible, even though it is premature to make this determination and ignores the benefits of remediation.

Draft Operable Unit 1 and Operable Unit 2 Feasibility Study (FS) – Dated March 30, 2018

- Olin was unresponsive to USEPA's request to include a robust discussion and summary of the data collected of all materials (including soils at depth and DAPL) that remain within the Containment Area and whether these data exceeds thresholds for a characteristic hazardous waste (and whether RCRA Subtitle C requirements are applicable for the Containment Area). These data will have applicability regarding potential cap selection as part of the FS evaluation.

  The FS includes only generalized discussions regarding former response actions conducted at the Former Drum Areas A and B and the Buried Debris Area. These areas comprise only a small portion of the Containment Area. Because only shallow soils within the Containment Area were characterized as part of the RI, and only surficial exposure included in the risk assessment, the FS should include a full range of remedial alternatives to address deeper soils within the Containment Area.

Previous USEPA comments (July 26, 2013) on the OU1 & OU2 BHHRA stated that "It is EPA's position that subsurface soils beneath the cap must be evaluated for potential industrial/commercial worker exposures until such time as the cap is made permanent." Additionally, in USEPA's Comments and Conditional Approval dated November 11, 2014 on the Draft Final Remedial Investigation and Risk Assessment Reports, dated April 10, 2014, USEPA requested that the risk assessment for the Containment Area clearly state that the nature and extent of subsurface soil contamination is unknown. Olin was unresponsive to both USEPA requests.

- The Containment Area and DAPL are ongoing sources of site contamination, and as such, source control alternatives should be developed for the Containment Area. Source control alternatives were not discussed in the FS. Multiple potential source control alternatives exist, including extraction of DAPL, diffuse layer, and otherwise impacted groundwater, on and/or off-site treatment or disposal of same.

- Olin was unresponsive to USEPA comments (in a letter dated December 7, 2017), that Olin remove language from the FS that presumed the installation of a permanent cap on the Containment Area (refer to page ES-1, last bullet and page 1-11, last paragraph of the OU1/OU2 FS). GeoInsight agrees with USEPA that this approach is inconsistent with the CERCLA and National Contingency Plan (NCP) processes. USEPA stated that "To comply with the NCP, the FS shall look at an appropriate range of alternatives for the Containment Area including no action, excavation and off-site disposal, ex-situ treatment, in-situ treatment, and capping."

- Olin was unresponsive to USEPA's request that clear Remedial Action Objectives (RAOs) be developed for soil (including soil in the Containment Area). Examples of applicable RAOs provided by USEPA include:

  - Prevent direct human contact/ingestion/inhalation with contaminated soils that exceed Applicable or Relevant and Appropriate (ARAR) and risk-based standards;

  - Prevent soil leaching and resulting contaminant migration to groundwater in excess of leaching-based standards; and

  - Prevent migration of contaminated soil to wetlands and adjoining properties.

- The screening of remedial technologies to address OU1/OU2 soil, sediment, and surface water did not include technologies that might have potential application at the OCSS including soil freezing (potential containment method), and artificial controls (i.e., constructed culverts for certain areas of surface water). Solidification for sediment/soil and permeable reactive barrier for surface water should have not been screened out as potential remedial technologies.

- The integrity of the Containment Area slurry wall remains in question (this comment is expanded upon under GeoInsight's comments on the OU3 RI below). Contaminant leaching of impacted soil in the Containment Area could result in contaminant migration to surface water, groundwater, and wetlands of OU1/OU2.

- Olin was unresponsive to USEPA's request to delete from the FS their statement that the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000 is not an ARAR (FS, page 2-5, first paragraph). Multiple (and OCSS-applicable) references to the MCP as an ARAR can be found in the recent 2017 Wells G&H Southwest Properties (OU4) ROD, and the 2015 Nuclear Metals ROD. Two (of many) relevant examples includes 310 CMR 40.1003(7) as that regulation applies to evaluating residual LNAPL at the former Plant B Area and 310 CMR 40.1070(4) as that regulation applies to Institutional Controls (i.e., an Activity and Use Limitation in Massachusetts). Olin inappropriately includes regulatory language of the MCP multiple times in their discussions regarding groundwater classification in OU3 and the BHHRA.

- The Purchase and Sales Agreement between Olin and New England Transrail, LLC should have no bearing on the FS process and/or evaluations (page 3-2, first paragraph).

- The on-site consolidation of soil/sediment under a capping system should be retained for full consideration (the FS did not provide a detailed justification for the elimination of this option, other than a generic "Cost" consideration).

  In Tables 1, 2, and 3, Olin often screens out an individual technology because it may work for some COCs but not for others. It is common to develop remedial alternatives that include combined remedial technologies to best achieve the stated RAOs. The final remedial action could also include different remedial technologies that are implemented in separate areas of OU-1 and OU-2. The FS should include consideration of combining technologies, and, therefore, individual technologies should not be excluded during this preliminary evaluation.

- Olin was unresponsive to USEPA's request to revise the ecological PRG for ammonia.

- Olin was unresponsive to USEPA's request to explain why the remediation area in the Lower South Ditch is assumed to be only one foot deep, and to provide an explanation of why underlying contaminated mineral soils will not be addressed.

- Olin was unresponsive to USEPA's request to include a plan for re-planting the Lower South Ditch remedial area after soil excavation and re-grading.

- Olin was unresponsive to multiple USEPA requests to modify language regarding the effectiveness of the RCRA C cap to the RCRA D and asphaltic caps for the Containment Area.

- In their selection of Alternative 2C, Olin fails to provide sufficient data and analysis to demonstrate that a RCRA D cap would satisfy ARARs.

  An area of PCB-impacted soil located in the former electrical substation area on the northwest portion of the Property was identified by Olin during RI activities. Olin concluded that the reported concentrations of PCBs do not pose risks above CERCLA limits for current or future workers. The maximum concentration of PCBs in surface and shallow soils reported during the OU1/OU2 RI is approximately 13 mg/kg, which is below the TSCA regulatory limit of 50 mg/kg for PCB remediation waste. Olin indicated that no further effort is required to address these soils".

GeoInsight disagrees with Olin's interpretation the PCBs detected in shallow soils. Soils that contain PCBs above 1 mg/kg should be addressed by the FS, and the FS should include a full range of potential remedial options. In USEPA's Comments and Conditional Approval dated November 11, 2014 for the April 10, 2014 Draft Final Remedial Investigation and Risk Assessment Reports, USEPA requested that alternatives be compiled in the pending FS to include actions to address the PCB area. Olin was unresponsive to this request.

Draft Remedial Investigation (RI) Report Operable Unit 3 – Dated March 30, 2018

- Olin was unresponsive to USEPA's request in their May 15, 2015, Conditional Approval Revised OU3 Data Gap Analysis and Additional Field Studies Work Plan (Comment No. 2) to include concentration contour maps (i.e., isocontour maps or plume maps).

  These plans only show concentrations as small circles around monitoring wells, and do not interpolate or project the concentrations into areas outside of the individual monitoring wells. COC distribution information is represented in plain view by applying Jenks Natural Breaks classes to data for individual wells. Most of these COC distribution plans do not indicate the extent of impacts in groundwater as a contour (concentrations are inferred between wells with a Jenks class and wells that are "not detected)" The Jenks class figures are difficult to interpret because the range of concentrations vary from COC to COC and are individual to each map because the classes are reflective of the variability of the data set. It is not clear why the Jenks method was deemed necessary to present the Site groundwater data compared to standard isoconcentration contour maps. Standard isoconcentration contour maps provide a better representation of the shape, aerial extent, and relative distribution of COC impacts, and are more useful in identifying remedial alternatives.

- The RI discusses COC information for individual watersheds (i.e., separate discussions for the Ipswich and Aberjona watersheds. Information was not provided to justify such treatment, and whether the occurrence and behavior of the COCs in each watershed varied to the degree that the impacts could not be characterized collectively. Remedial action objectives developed in the FS should apply equally to both watersheds.

- The discussion of domestic gray water as a source of NDMA detected in groundwater adjacent to or nearby residential wells is speculative and was not evaluated by RI-specific field activities. The reference should be eliminated from the RI in the absence of actual field investigations at these locations that conclusively identify gray water as a NDMA source.

- The numerical matrix diffusion modeling included in Appendix K is a non-standard modeling exercise. GeoInsight was not aware of, nor did we have an opportunity to review, the modeling work plan. A preliminary review of Appendix K indicates that the matrix diffusion modeling was conceptual in approach and overly simplistic. Based upon a preliminary review of the model, we believe that the modeling effort and associated results do not address the RI report's stated objective of "to better understand the implications on contaminant fate and transport from long term exposure of fractured bedrock to high concentrations of

NDMA….” We also disagree with the premise that site-specific analyses, modeling, and evaluations are required to conduct the required FS analyses of potential remedial action alternatives. We have seen no information to indicate that conditions at the OCSS are significantly different and/or more complicated than many other CERCLA sites that include bedrock contamination.

- “DAPL” and “diffuse layer” are not defined technical terms; they are terms created by Olin to describe a range of certain groundwater conditions associated with the Site. Both terms refer to contaminated groundwater. Historically, Olin has described certain expected and/or hypothesized behaviors associated with these categories of groundwater impacts for which little site-specific information and or sampling data had been presented (i.e., aquifer clogging, layer interface waves/disturbances, etc.). Groundwater conditions, potential risks, and possible remedial actions should be evaluated for all groundwater (including “diffuse layer” and “DAPL”).

- Section 3.3 (Overburden Groundwater Hydrology) of the RI focuses heavily on describing hydraulic conditions of the 51 Eames Street property and the area of the hydraulic divide between the Ipswich and Aberjona basins. The RI includes very little discussion of flow conditions within the Maple Meadow Brook (MMB) aquifer, which comprises a large percentage of the Site. A large portion of MMB aquifer was impacted by COCs from the OCSS. The RI should include a more robust description and discussion of hydraulic conditions within the MMB portion of the Site, including anticipated groundwater flow and discharge conditions, and interactions with the two significant surface water features (Sawmill and Maple Meadow brooks). The geologic cross sections should be augmented to include hydraulic and contaminant distribution information.

- Olin’s discussion regarding hydraulic changes since cessation of municipal well pumping was insubstantial and focused primarily on the groundwater divide. It is unclear whether other historical data sets were evaluated other than the water level maps prepared by Smith in October 1995 and April-May 1996.

- Section 2.2.5 indicates that the slurry wall hydraulic pulse interface (HPIT) testing concluded that a stable hydrogeologic condition exists within the slurry wall, and that the slurry wall and the Containment Area continued to serve its intended purpose and are structurally sound. The conclusions are not accurate. One of the tests clearly showed a pulse transmitted across the slurry wall. The other tests were inconclusive because the monitoring points were too far away from each other to effectively monitor the pulse. Therefore, there is no technical justification to conclude that the slurry wall is not hydraulically compromised.

- Olin was unresponsive to USEPA’s request (in correspondence dated December 7, 2017) to delete Olin’s recommendation of no further testing related to the slurry wall. In Section 2.2.5, page 2-24 of the OU3 RI, Olin states that “The USEPA accepted Olin’s recommendation of no further testing related to the slurry wall.”

- Table 3.3-4 includes errors regarding the identified vertical gradients for well nests GW-42 and GW-45.

- Figure 1.3-3 (3-D View of Slurry Wall Containment Area Looking South West) is difficult to interpret and should be modified and/or replaced with alternative figures that more clearly display the information.

- DAPL areas are not shown on Figure 2.1-3 (Bedrock Monitoring Wells).

- Figures 2.2-3 and 2.2-4 (Groundwater Elevations in Deep Monitoring Wells) – estimated groundwater flow directions are not drawn correctly (perpendicular to groundwater elevation contours).

- Estimated groundwater flow lines are not included on Figures 2.2-5/2.2-6 (Groundwater Elevations in Bedrock Monitoring Wells) and Figures 3.3-1/3.3-2 (Groundwater Elevations in Shallow Monitoring Wells).

- Figure 3.2-6 (Bedrock Features and Surface Topography) is missing certain contour intervals (60-foot and 70-foot) in the northeast portion of the map.

- Figure 3.2-7 (Interpreted Fault Traces) is based upon 1997 investigations that were not part of CERCLA activities; as such, we are not aware that the interpretation of data obtained in the study has been independently verified. In addition, it would be helpful for the figure to include the footprint of DAPL areas, and the locations of deep overburden and bedrock monitoring wells.

- GeoInsight disagrees with Olin's assessment and interpretation of data for monitoring well GW-83D and the extent of DAPL and diffuse layer within the central portion of the MMB aquifer. This pool is currently defined as a small circle on RI maps, but the actual location of the DAPL pool boundaries have not been identified by field investigation. It is unclear how the GW-83D DAPL pool was evaluated and delineated. We are not aware of additional monitoring wells or field sampling activities that were completed to define the extent of groundwater impacts (DAPL and Diffuse layer inclusive) in the GW-83D area. The DAPL pool could be larger than depicted or expanding over time. This portion of the OCSS is important because it is located within the center of the MMB aquifer and in close proximity to the Town's inactive municipal supply wells.

  Additionally, information provided by Nobis in their Technical Memorandum – Potential for Diffuse Plume Expansion dated July 12, 2017, indicated that well GW-83M, located in the plume core above highly contaminated groundwater, has exhibited statistically significant concentration increases in ammonia, chloride, NDMA, and sulfate over time. The Nobis memorandum summarized that "Available data collected between 1990 and 2010 suggests that contaminant concentrations may be increasing in certain portions of the plume and the contaminant plume may be expanding…"

  Olin also suggests that geologic structures (i.e., vertical faults) are located in the vicinity of the MMB DAPL pool and that "It is unlikely that the presence of these geologic structures allowed a stable pool of DAPL to persist within this portion of the Western Bedrock Valley (WBV)." This statement is hypothetical and is not supported by technical characterization data reviewed by GeoInsight to date.

GeoInsight is in agreement with USEPA's comment in correspondence dated December 7, 2017, that "The volume of the DAPL pool under MMB (GW-83D) is ignored."

GeoInsight also agrees with the following comment provided to Olin by USEPA in correspondence dated USEPA's May 13, 2015 regarding the MMB DAPL pool:

> **6.** Nature and Extent of DAPL in MMB. The dimensions of the small DAPL pool shown on the figure within the MMB wetland are unknown. This pool is currently defined as a small circle at the GW-83 cluster. Given that the bedrock topographic low in this area appears to extend to the northwest (southwest of MP-5 and east of the GW-88 cluster), what evidence is there that DAPL would not extend throughout this bedrock low? Olin/AMEC may elect to investigate bedrock depths and/or add additional well control to determine this. Although Olin/AMEC have defined this DAPL pool as a relatively small area, it appears to be a significant source of contamination to the MMBW and downgradient residential wells, as shown by the diffuse layer delineation (Figure 2.1-8). EPA and the stakeholders remain concerned that this DAPL pool (around 83D) is likely much larger than currently delineated or there are other DAPL sources in the MMB wetland given the large area of diffuse groundwater in this area.

Olin was generally unresponsive to USEPA's comment as indicated below.

Response to Comment 6: The nature of DAPL identified in MMB will be discussed in the OU3 RI report and no additional field work is necessary to complete the OU3 investigation with regard to this question (Olin correspondence dated July 3, 2015).

- On the COC distribution figures, the map scale is consistent for shallow and deep overburden plans, and different for the bedrock plan. The change in scale makes it difficult to compare distribution between the three groundwater zones.

- The COC distribution figures demonstrate that for multiple COCs, their extent in groundwater has not been defined to the northeast and east of the 51 Eames Street property (i.e., elevated concentrations of COCs are present in groundwater samples collected from the easternmost monitoring wells in this portion of the Site).

- The RI report recommends that a Technical Impracticability Evaluation (TIE) be formally initiated to evaluate technical barriers for restoration of bedrock groundwater (i.e., NDMA, DAPL, diffuse groundwater) in a "reasonable time frame" within the Ipswich watershed. This recommendation is premature and a more thorough review of remedial alternatives is required. Appropriate remedial alternatives have been selected and implemented before a TIE is warranted, and then only if field data indicate such an evaluation is warranted.

- Olin makes several unsupported statements regarding the formation processes and origin of NDMA. GeoInsight agrees with USEPA that the NDMA Precursor Study performed by Olin in 2004 should be summarized and included in the OU3 RI Report to support these statements. An evaluation of residual concentrations of the precursor chemicals in soil and groundwater and a discussion of NDMA concentration trends to demonstrate that NDMA is no longer being formed (USEPA, December 2017). Additionally, Olin did not consider the potential for the presence or formation of other nitrosamines in association with NDMA.

- Summary tables of groundwater analytical results (provided in Appendix E) do not include comparisons of detected constituents to published standards or risk-based concentrations. This makes it difficult to fully evaluate the nature and extent of groundwater impacts at the OCSS.

Draft Operable Unit 3 Feasibility Study – Dated March 30, 2018

- Section 1.4.2 (Groundwater) indicates that pumping of the Town wells historically caused large drawdowns that would have resulted in upward vertical movement of bedrock groundwater into the overlying deep overburden groundwater. This statement is overly broad and only limited supporting information is provided.

- The FS does not include technologies and remedial alternatives to prevent the further migration of DAPL and other contaminated groundwater from within the Containment Area.

- A stated conclusion of the RI report that is referenced in Section 1.6 of the FS includes the statement that the mass of DAPL and NDMA that is retained by matrix diffusion within the Western Bedrock Valley is significant enough to render treatment of bedrock groundwater by extraction and treatment technically infeasible. GeoInsight strongly disagrees with this conclusion, which is based on limited field tests of small areas and a simplistic modeling study that should not be used to develop such conclusions.

- A stated conclusion of the RI report that is referenced in Section 1.6 of the FS includes that future use of the Town wells will induce upward vertical gradients from underlying bedrock groundwater to deep overburden groundwater, and therefore restoration of the MMB overburden aquifer to potable quality is not feasible in the foreseeable future.
  This conclusion is conjectural and unsupported. This conclusion also does not include the potential benefits of remediation that would restore portions of the MMB overburden aquifer.

- GeoInsight disagrees with Olin's classification of drinking water source areas. The RI should consider that all groundwater located at the OCSS represents a potential exposure pathway for human ingestion, regardless of location with respect to surface water drainage basins and estimated groundwater flow divides. The OU3 RI should consider the portion of the Aberjona watershed within the OU3 study area to be a drinking water source. Olin was unresponsive to USEPA and MADEP requirements to consider both the Ipswich and Aberjona watersheds to be active and potential drinking water sources.

- Olin contends that DAPL extraction in the Off-PWD DAPL pool is limited to gravity flow to bedrock lows at 0.5 gpm pumping rate. In e-mail correspondence to USEPA dated July 9, 2014 and Memorandum dated February 26, 2015, GeoInsight provided USEPA with comments regarding the results of Olin's DAPL Extraction Pilot Study, specifically questioning Olin's assertions regarding DAPL pumping/recovery rates. We disagree with Olin's conclusion that the pumping rate must be limited to gravity flow, and we have been provided with no new information or evaluations that have changed the opinions that were presented in July 2014 and February 2015. The FS must evaluate other pumping scenarios and extraction well construction and configurations (e.g., horizontal wells) to remove DAPL, diffuse layer, and other contaminated groundwater.

- Olin has often asserted that it is important to limit DAPL-diffuse layer mixing and interactions. Technical information to support such an assertion is limited, and often appears to be speculative (i.e., mixing would lead to significant mineralization and soil clogging). Sufficient information has not been provided to support that this technical consideration should be weighted so heavily in the evaluation of remedial alternatives.

- The Development of Remedial Action Objectives (RAO) in Section 2.1 of the FS was cursory and incomplete. The RAOs listed in the FS focus primarily on preventing exposure to DAPL. RAOs must be developed to address the significant quantity of COC-impacted groundwater at the Site, and should include an objective of removing, treating, reducing, and/or containing all impacted groundwater at the Site (including DAPL, diffuse layer, and impacted groundwater).

- One of the RAOs put forth in the OU3 FS was to "Reduce, to the extent practicable, mobility or volume of DAPL constituents in the DAPL pools that present a source of long-term impacts to groundwater and surface water." Apparently, remedial alternatives for DAPL were only evaluated or considered for the Off-Property West Ditch (Off-PWD) DAPL pool. RAOs should be developed to address all on- and off-property DAPL. Examples of RAOs that could apply to DAPL were provided by USEPA in correspondence dated December 7, 2017 and include:

    - Remove and/or contain DAPL and residual DAPL to the extent practicable, as a source control measure.

    - Prevent human exposure to DAPL containing concentrations of contaminants that contribute to cxceedances of groundwater and/or soil ARAR and risk-based standards.

    - Prevent DAPL migration, leaching to groundwater, and discharge to wetlands.

- Selected remedial alternatives do not include extraction of DAPL from the Containment Area, Main Street DAPL Pool, and well GW-83D area. It is appropriate to assume that, without remedial actions, DAPL, Diffuse Layer, and impacted groundwater will be an ongoing source for NDMA in groundwater and associated potential exposures.

- The list of RAOs should be expanded to include considerations such as "Prevent potential human exposure (ingestion/dermal contact/vapor inhalation) by a future resident to overburden groundwater used as a water supply with COC concentrations that exceed ARARs or result in a cumulative excess lifetime cancer risk greater than 10-4 or non-carcinogenic HI greater than 1," "Restore the overburden and bedrock groundwater within the contaminant plume, to a level protective of human health and the environment and meeting ARARs", and "Limit migration of COCs in groundwater at concentrations that would exceed ARARs or result in a cumulative excess lifetime cancer risk greater than 10-4 or non-carcinogenic HI greater than 1 for a future resident exposed to the groundwater by ingestion, dermal contact, and vapor inhalation."

- RAOs or remedial alternatives were not developed to address groundwater impacts and residual light non-aqueous phase liquid (LNAPL) smear zone soil associated with the former Plant B operations. The LNAPL is a process oil that contains bis(2-ethylhexyl)phthalate (BEHP), N-nitrosodiphenylamine (NDPA), and trimethylpentanes (TMPs).

- The preliminary screening effort described in the FS appears to be cursory, limited-in-scope because of the focused nature of the stated RAOs, and insufficient in breadth and scope given the Site complexities. The FS should include a more robust discussion of conditions that require remedial actions and possible remedial approaches to serve as a basis for evaluations completed during the initial screening of remedial alternatives.

- The FS does not indicate how the "primary COCs" for OU3 were established (risk based, mass based, distribution based, etc.).

Table 2.3-1 Screening of Remedial Technologies

- The table did not consider remedial approaches that include combinations of technologies. Technologies were inappropriately screened out if they were not capable of achieving all the stated RAOs independently.

- Technologies that were screened out just because they are not able to treat NDMA should be retained to be evaluated in combination with methods that can treat NDMA.

- The FS did not include a complete evaluation of ex-situ water treatment methodologies.

- The FS did not include a complete evaluation of in-situ water treatment methodologies, including in-situ geochemical fixation.

- Groundwater extraction methods should include consideration of interceptor/extraction trench and/or directionally-drilled extraction wells.

- Soil excavation should be considered for the containment area.

- ISCO should be retained for groundwater treatment.

- Adsorption should be retained for groundwater treatment.

- UV Oxidation should be retained for groundwater treatment.

- Containment remedies should include hydraulic containment response actions, such as groundwater extraction for hydraulic control.

- In-situ grouting should be retained as a possible containment remedy associated with bedrock groundwater contamination.

- Soil freezing should be considered as a possible containment remedy in combination with groundwater extraction and treatment in localized DAPL areas.

Draft Baseline Human Health Risk Assessment Operable Unit 3 – Dated March 2018

- It is reasonable to assume that, absent remedial actions, DAPL will be an ongoing source for NDMA (and other constituents of concern) in groundwater and associated potential exposures. The presence of NDMA in groundwater associated with the OCSS requires remedial action under CERCLA. As such, exposure to DAPL, Diffuse Layer material, and other impacted groundwater should be considered in the BHHRA.

- Olin was unresponsive to USEPA and MADEP requirements to consider both the Ipswich and Aberjona watersheds to be active and potential drinking water sources. The BHHRA evaluates the Aberjona watershed for non-potable use only. Inclusion of the Aberjona watershed as a potential drinking water source would fundamentally change several components of current draft BHHRA (i.e., exposure scenarios, EPCs, COPCs, etc.). For example, Olin states that "The current and potential future receptors are linked to the classification of the groundwater in the two watersheds (Ipswich River and Aberjona River) and the aquifers (overburden and bedrock)." GeoInsight agrees with USEPA/MADEP's position that the Aberjona watershed should be considered for groundwater ingestion exposures.

- We agree with USEPA's position that "The pumping and ingestion of DAPL is a viable potential future pathway of exposure and must be assessed as such." The BHHRA does not include potential exposure to Diffuse Layer groundwater (i.e., ingestion, dermal contact, and inhalation).

- In the past there has been some discussion regarding whether the MCP is considered an Applicable or Relevant and Appropriate Requirement; regardless, the BHHRA appears to rely heavily upon MCP guidance, regulations, and considerations associated with drinking water source areas. USEPA CERCLA guidance and convention should be the starting point for discussions and evaluation of applicable exposure routes. Unlike the MCP, which requires drinking water exposures to be included for only certain types of properties, it has been our experience that CERCLA considers that for most properties, there is the potential that groundwater might be used as a source of public or private drinking water in the future. As such, groundwater ingestion is a potential exposure pathway that is included in most CERCLA risk assessments.

- Throughout the text of the BHHRA Olin uses various terms to describe the potential for exposure to DAPL such as "highly unlikely," "highly improbable," "not a likely scenario," "exceedingly improbable," and "extraordinarily improbable." Olin was unresponsive to USEPA's request to remove this language form the BHHRA. GeoInsight agrees with USEPA that exposure to DAPL is a potential future exposure as it could be pumped from the aquifer and ingested.

- In a previous comment on the OU1 & OU2 BHHRA (July 26, 2013), USEPA stated that "EPA expects to see an evaluation of all groundwater, including DAPL, as potential future drinking water in the OU3 risk assessment."

- In a previous comment on the OU1/OU2 BHHRA (July 26, 2013), USEPA indicated that Olin evaluated only Reasonable Maximum Exposure (RME) and no central tendency exposure (CTE) evaluation. USEPA Guidance indicates both scenarios should be evaluated to provide a range of risks for risk management consideration. Olin has not considered the use of CTE in the BHHRA.

- Considerations discussed in the BHHRA regarding the elimination of potential future exposure pathways via institutional controls is inconsistent with USEPA methodology (page 1-6, first paragraph).

- Olin's use of the term "chemicals of interest" (COI) in the BHHRA is confusing and misleading and is not a typical term in CERCLA guidance or the NCP. Use of the term appears to add an unnecessary level of complexity to the BHHRA. Olin was unresponsive to USEPA's request to discontinue use of the term.

- According to information provided in the OU1/OU2 RI, residual LNAPL-impacted soil remains in the vicinity of the Plant B Tank Farm at depths ranging from approximately 6 to 10 feet below the ground surface (bgs). Olin stated that "Impacted soil is below the water table and is associated with the LNAPL smear zone and is more appropriately managed as part of OU3." The OU3 RI acknowledged that residual LNAPL-impacted soil was a source of impacts to groundwater. However, according to information provided in the BHHRA, the BHHRA did not evaluate saturated soil human exposure or associated risks, since these saturated soils are considered isolated and the potential for human exposure to those soils is very low. Under typical construction scenarios, excavation/construction activities could reasonably expect to encounter LNAPL and LNAPL-impacted soil/groundwater at depths ranging from 6 to 10 feet bgs in the former Plant B Area. The BHHRA should include potential exposure to this impacted soil.

- It is unclear how human and ecological risk associated with residual LNAPL-impacted soil was addressed in either the OU1/OU2 BHHRA or the OU3 BHHRA.

If you have questions regarding these comments, please do not hesitate to contact us.

Sincerely,
GEOINSIGHT, INC.

Kevin D. Trainer, C.P.G., P.G., L.S.P.
Senior Associate

Michael J. Webster, P.G., L.S.P.
Regional Manager

Joel J. Trifilo, P.G., L.S.P.
Senior Geologist

cc: Jeffrey Hull, Town Manager
Shelly Newhouse, Director of Public Health

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PROJECT MEMORANDUM

To: Jim DiLorenzo, Environmental Protection Agency | Date: May 10, 2018

From: Kevin Trainer | GeoInsight Project 5611-003
Joel Trifilo
Michael Webster

Cc: Jeffrey Hull, Wilmington Town Manager

Re: Rock Matrix Sampling Work Plan
Olin Chemical Superfund Site
51 Eames Street
Wilmington, Massachusetts

GeoInsight, Inc. (GeoInsight) prepared this memorandum to provide preliminary comments on the Rock Matrix Sampling Work Plan (the Work Plan) that was prepared by Wood Environment & Infrastructure Solutions (Wood) for the Olin Chemical Superfund Site (the Site) in Wilmington, Massachusetts. Because we were provided limited time to review the plan, which proposes multiple non-standard methods for testing and investigation, our comments are preliminary and focused on strategic project considerations.

Based upon our preliminary review of the Work Plan, we have the following observations:

- the stated objectives of the Work Plan do not appear to be directly applicable to the ongoing Remedial Investigation (RI) and Feasibility Study (FS) activities;

- based upon the limited scope of the proposed Work Plan, both in location and in technical rigor given the complexity of the associated technical issues, it is questionable that the study results will have wider applicability to other portions of the Site;

- the proposed Work Plan relies upon non-standard and/or new methods to conduct analytical testing and bedrock water sampling; as was seen with the hydro-pulse testing near the containment cell, use of non-standard methods often provides results that are not readily interpreted and for which conclusions are often qualified and limited;

- it is not apparent that Site-specific studies are needed to conduct the necessary FS evaluations regarding remedial methods to address groundwater impacts at the Site, including in bedrock; to obtain Site-specific results upon which such evaluations could be based would require a significantly more substantial and robust evaluation and testing program than the one proposed in the Work Plan; and

- information presented in the Work Plan is suggestive that the data collected will be used to demonstrate that remediation of bedrock groundwater is not feasible; it is GeoInsight's opinion that information obtained from the Work Plan will have limited applicability to a discussion of the feasibility of remediating bedrock groundwater at the Site.

PROPOSED WORK PLAN OBJECTIVES

In Section 1.0 Introduction, the Work Plan indicates that the objective of the study is to "determine the presence and concentration of N-nitrosodimethylanine (NDMA) in the bedrock matrix immediately adjacent to the Main Street Dense Aqueous Phase Liquid (DAPL) pool."

The concentration of NDMA in the bedrock matrix is much more difficult question to address, and similarly, knowing what the concentration is in one, or a few locations, is of limited value with regard to questions being addressed on a larger, Site-wide scale. In particular, we anticipate technical considerations regarding the long-term possible impact of matrix diffusion out of bedrock as it relates to possible rebound and/or continued long-term diffusion of NDMA from rock into the nearby groundwater. It is not certain that Site-specific studies are needed to address this technical consideration. In addition, the scope proposed in the Work Plan is not sufficient to provide the data necessary to address the consideration of bedrock matrix-diffusive rebound for the Site.

In Section 2.3 Objectives, the Work Plan lists the following three objectives:

- **confirm NDMA presence and quantify contaminant mass in the bedrock matrix.**

- **characterize transmissivity of the entire borehole so that zones of low transmissivity can be identified and related to specific rock features.**

- **develop and implement a method to sample and characterize groundwater in low transmissivity bedrock.**

The limited scope of the Work Plan is such that the quantification of contaminant mass and characterization of low transmissivity zones will only be directly applicable to the immediate area of the individual borehole used in the study. To be able to draw Site-wide conclusions would require substantial more testing and data to demonstrate that the full range of bedrock conditions have been characterized, and that relationships can be correlated Site-wide (i.e., a particular kind of bedrock fabric would be expected to contribute a particular quantity of back diffusion).

We have significant reservations of the efficacy of the method that is proposed to “develop a method to sample and characterize groundwater in low transmissivity bedrock.” It appears that significant testing of the method would be required to demonstrate its reproducibility in multiple configurations and settings. The Work Plan does not indicate how the results obtained using a vacuum/lysimeter approach will be applied to evaluations of back-diffusion, and/or chemical gradient “leaching” back into bedrock/overburden groundwater.

The last paragraph of Section 2 Problem Statement indicates that microfractures are typically present in bedrock, and that it is critical to understand the behavior of groundwater hydrology and fate and transport not only in interconnected fracture system but also in rock matrix. The second paragraph of Section 3.1.3 Sample Extraction and Analysis indicates that the primary goal of the sampling event and analysis method is to determine the total concentration of NDMA in the rock matrix to evaluate the retention of NDMA in the bedrock media.

In general, matrix diffusion, whether to bedrock or soil matrices, is present at most release sites. The presence of matrix diffusion does not automatically disqualify remedial efforts that would have a beneficial effect at a Site. Although release constituents may diffuse into rock or soil matrices, the mass of diffused release constituents is typically very low compared to the contaminant mass that remains un-diffused (and recoverable). For this Site, it is our opinion that evaluation of the full-scale remedial efforts can appropriately be evaluated without Site-specific information regarding potential matrix diffusion. Regardless, the limited scope proposed in the Work Plan is insufficient to address fate and transport considerations associated with the rock matrix at the Site.

Impacts from the release at the Site extend over a large area. There has been no information provided to suggest that the bedrock composition, degree of fracturing, or contaminant distribution at the Site is homogenous or isotropic. The study proposes to obtain data on an extremely small portion of the Site (one boring), draw conclusions from those results, and apply those conclusions to the remainder of the Site. Such an approach is without technical basis or justification. We consider it to be effectively impracticable to translate the limited results from a focused, small-scale study, into actual effects across the entire impacted area. Due to the known heterogeneities at the Site, we do not consider that field or laboratory bench tests would provide useful, Site-wide, information about potential matrix diffusion.

Section 3.3 Low Transmissivity Bedrock Groundwater Sampling and Analysis describes a “type of system that has not been developed and implemented previously” to attempt to sample groundwater from bedrock microfractures.

We have significant concerns that the proposed methodology can provide accurate and reproduceable results. We also have reservations regarding exactly what the “sampling” results will represent, and how they will be used in the FS evaluations. We also have concerns regarding:

- use of a vacuum to obtain the sample (eliminates natural flow conditions and is not related to diffusive processes);

- relationship of strength of vacuum to volume of sample obtained;
- relationship of duration of vacuum to volume of sample obtained;
- ability to maintain constant vacuum;
- potential for short-circuiting and induced flow into suction area;
- dependability of sampling apparatus; and
- variability associated with implementing the methodology in the field.

Jennings, Lynne

From: Waldeck, Garry (DEP) <garry.waldeck@state.ma.us>
Sent: Monday, July 16, 2018 11:08 AM
To: DiLorenzo, James; Brandon, William
Cc: Smith, Christopher
Subject: RE: Olin -

Jim-

I have already sent you comments on the Containment Area Boring Memo. Here are my comments on the Appendix H of OU3 RI Report:

1. This is a conceptual model which is not reflective of the actual bedrock conditions. For example this model uses perfectly continuous and perfectly vertical and horizontal fractures and predicts that the DAPL continues to sink deeper and deeper into bedrock continuing forever. This does not match actual site conditions because there is not perfectly continuous vertical fractures as well as a continuous horizontal fracture. In reality not all fracture are connected.

2. This model indicates that the top ten feet of the bedrock surface is highly weathered and fractured. Please explain why this bedrock is different than the bedrock below the containment area which Olin has indicated is competent.

3. This model uses a constant dissolved concentration of NDMA seeping into bedrock. This may not reflect the actual conditions at the site because information to date has indicated that a DAPL is present above the bedrock not a dissolved plume.

4. Why did the model use one horizontal fracture and two vertical fractures? Why didn't the model use actual conditions? Why does the horizontal fracture under the footprint of the DAPL pool end at the limits of the pool?

5. Please explain why longitudinal dispersity was selected as 1 foot and 10 feet.

6. In section "Input parameters" please indicate which inputs are from literature and which are site specific measurements. Why, if the estimate of the fractures hydraulic conductivity is 0.5ft/d does the model use 5 ft/d?

7. The model used only 10 percent of total rainfall because of paved surfaces. However there is many areas with pavement that have sheet flow of precipitation to infiltration areas. 90% of precipitation does not get collected by storm drains. Please provide more information as to why 90 percent of total rainfall was removed from calculations.

8. Please provide a better scale to the figures. The figures are presented in Log format and it is difficult to measure the distances.

9. In the model results section the model does not show what impacts pumping would have on transport of the dissolved plume, DAPL, nor NDMA.

10. Conclusion Section- This model is an oversimplification of bedrock conditions and does not match the actual site conditions. This conclusion section should discuss the limitations of this model. If this model is to be further used it would have to be field verified and calibrated.

Garry

Garry Waldeck
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Visit our web site: http://www.mass.gov/eea/agencies/massdep/#

From: DiLorenzo, James [mailto:dilorenzo.jim@epa.gov]
Sent: Wednesday, June 27, 2018 8:33 AM
To: Brandon, William
Cc: Waldeck, Garry (DEP); Smith, Christopher
Subject: Olin -

Hi Bill,

There are 2 Olin reports I need your input on. I know you have both of these on your radar already, so I just want to check on your status of review.

1. The Draft Containment Area Borings Tech Memo (was sent to you by Chinny on June 15… courtesy copy attached). This summarizes the installation of two bedrock borings in the Containment Area (1 within, 1 just outside) to evaluate the integrity of bedrock in this area. I need to know your thoughts on boring locations, and Wood's interpretation of the results. Attached are comments provided by Nobis which question the conclusion by Wood/Olin that the shallow bedrock is competent. I totally agree with these comments.

2. The Draft OU3 RI Report, Appendix H. This appendix presents the numeric model presented by Olin to support their position on the Matrix diffusion. I need to know your thoughts on the assumptions and inputs. The draft OU3 RI report is too big for email, but I believe you have a copy. If not, I will upload on to the Q share directory. Attached are comments provided by Nobis; Appendix H comments are on pp. 25 and 26.

Please let me know when you may be able to provide written comments? EPA comments to Nobis are already 3 weeks late, so sooner would be appreciated.

Thanks,
Jim

James M. DiLorenzo
Superfund Project Manager
EPA Region 1 – New England

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Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

July 6, 2018
Mr. James DiLorenzo
USEPA
5 Post Office Square
Boston MA

RE: Comments on Containment area Bedrock Boring Results by Wood dated May 10, 2018

Dear Mr. DiLorenzo:

Thank you for the opportunity to review and comment on this Bedrock Boring Results document dated May 10, 2018 prepared by Wood. Below are MassDEP's comments.

The executive summary says that bedrock boreholes were installed to verify the nature of the bedrock and the dense Aqueous Phase Liquid. Both boring were outside the DAPL pool, please explain how borings outside the DAPL area can verify the nature of the DAPL.

The executive Summary states *"The boring inside the Containment Area and immediately adjacent to the associated DAPL pool encountered un-fractured and highly competent bedrock over the entire borehole (to a depth of approximately 180 feet below ground surface (bgs). The boring outside the area had only one likely water bearing fracture, which was at a depth well below the DAPL (approximately 175 feet bgs). The borings corroborate the previous findings that bedrock underlying the Containment Area is highly competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity."* However the boring log for OC-BB-1-2018 indicates that bedrock was encountered at 27bgs and then augured through two feet of weathered bedrock. From Figure 1 the DAPL pool is adjacent to the slurry wall and Cross Section A-A indicates that the bottom of the slurry wall is at approximately 22 BGS. Boring log for OC-BB-1-2018 also says that facture at 32ft BGS, fracture at 35.5 BGS, fracture at 40-40.5 BGS, and fracture at 67 BGS, contradicting the above Executive Summary statement.

Page 2 Bedrock Boring Installation OC-BB-1-2018 states that bedrock was encountered at 27 feet below ground surface and augers were able to penetrate nearly two feet into weathered bedrock. From the figures it appears that 27ft BGS is below the bottom of the slurry wall. Please provide detail as to how the deep the slurry wall is and how is it connected through the weathered bedrock below it.

Page 3 OC-BB-2-2018 The text states "*The borehole was quickly advanced, through cobbles, boulders, till, and weathered bedrock, to approximately 27 feet bgs where competent bedrock was encountered. The borehole was advanced to 30 feet bgs. Repeated attempts to clean out the borehole to 30 feet were unsuccessful due to cave in of material and approximately 6 feet of material could not be removed from the bottom of the borehole.* " This indicates that the top of rock is not competent. Please provide similar information on this side of the slurry wall as requested above. How deep is the slurry wall and how is it connected through this weathered bedrock?

Figure 1 shows the DAPL pool in contact with the western slurry wall, however the cross section A-A does not. Which is correct?

Conclusions. The DAPL is sitting on feet of weathered bedrock. This conclusion does not discuss how DAPL and/or diffuse groundwater contamination will travel through this weathered bedrock into deeper bedrock or under the slurry wall.

MassDEP disagrees that monitoring well GW-202BR and BR-1 verify the competency of the bedrock. Both GW-202BR and BR-1 show site related contamination. Please provide an explanation as to why GW-202BR and BR-1 verify the competency of the bedrock instead of providing just the statement.

Please provide Olin with these comments and ask for a response.

Sincerely,

Garry Waldeck
MassDEP
BWSC

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Commissioner

May 29, 2018
Mr. James DiLorenzo
USEPA
5 Post Office Square
Boston MA

RE: Olin Chemical Superfund Site Document review:
OU1 and OU2 Feasibility Study dated March 31,2018,
OU3 Remedial Investigation dated March 31,2018,
OU3 Feasibility Study dated March 31,2018.

Dear Mr DiLorenzo

Thank you for the opportunity to review and comment on the OU1 and OU2 Feasibility Study, OU3 Remedial Investigation, and OU3 Feasibility Study for the Olin Chemical Superfund Site in Wilmington MA. Below are MassDEP's comments on the documents. Please include this comment letter in your correspondence with Olin and please request revisions to these documents and request them to be resubmitted for review and comment.

OU1 and OU2 Feasibility Study

1.The FS should provide remedial alternatives for all areas of concern at the site including areas subject to past voluntary deed notices. Any Institutional Controls must approved as part of the overall site remedy.

2.There is no site conceptual model presented in the FS.

3.Page ES-1 Third bullet please delete "Installation of a permanent cap over the" and leave "OU1 Slurry Wall Containment Area"

4.Page ES-1 There are no remedial Action Objectives listed for the soils in the current deed notice. The FS should include RAOs for all areas of concern at the site.

5.Page 1-1 The FS states "This revised OU1 & OU2 FS addresses groundwater interaction between OU3 and OU1/OU2" however the RI says that this is an OU3 issue. Please indicate where in this FS this issue is addressed.

6.Throughout this document and the OU3 RI and FS there are references to this site being a MCP site. This site is not considered Tier 1 site, it is classified as Adequately Regulated. Further, action taken while regulated under the MCP were not completed to MCP end points and regulation of this site was transferred to USEPA. All areas that were partially remediated should be included in this FS. For example:

1. on page 1-4 the report states "...response activities carried out by Olin Corporation, and supervised by MassDEP under the MCP. Response actions include several actions completed in the vicinity of the Slurry Wall and Containment Structure. These MCP response actions, discussed in the Draft Focused RI Report (MACTEC Engineering and Consulting, Inc. [MACTEC], 2007), include Release Abatement Measures (RAMs) for Former Drum Areas A and B and the Buried Debris Area." A RAM not a RAO and doesn't mean site was cleaned up. These areas have residual contamination. Any area with residual contamination which may be subject to long term institutional controls should be presented and disused in this FS.
2. "The OCSS also contains a Slurry Wall/Containment Structure that was constructed in 2000/2001as a RAM approved by MassDEP while the OCSS was regulated under the MCP. The location of the Slurry Wall/Containment Structure is shown on **Figure 1.3-1**. The purpose of the SlurryWall/Containment Structure was to achieve a permanent source control measure for the on-Property DAPL Pool, consistent with requirements of the MCP. The objective of this source control action was to eliminate, to the extent feasible, the on-Property DAPL source material as a source of dissolved constituents to groundwater." Note-the Slurry Wall/ Containment area was only conditionally approved and a reason for transferring the site to USEPA was because conditions were not being met.

7.Page 1-3 OU1 Please edit this to says that this RI/FS evaluates soil less than 10 feet below ground surface or please include a discussion about such. The document states" It should be noted that soils in the vadose zone are evaluated in this report; soils located within the water table are evaluated under OU3." Please indicate where this is evaluated. A search of the document for the word vadose only comes up this one time.

8.Page 1-4 states "...Twenty-nine of the 163 drums were characterized as hazardous waste". This FS should discuss any contamination potentially left in place after the drum removal.

9.Page 1-5 Please provide more information on the following, (such as what concentration s and volume of soil was left in place): FS states " As discussed in the Draft Focused RI Report (MACTEC, 2007), Olin completed closure of the Lined Lagoons as part of the initial site closure activities initiated in 1986. These activities were completed in accordance with the closure plans approved by the MassDEP. No additional source control measures were necessary for the former Lined Lagoons. The location of the former Lined
lagoons are shown on **Figure 1.3-1**.

10.Page 1-5 FS states that "Containment Structure is performing as designed as a source control measure for the on-Property DAPL Pool." However the figures show the pool leaking under the wall. Does the DAPL escape under the wall?

11.Section 1.4 Nature and Extent of Contamination. This section should discuss all areas with soil contamination. Including areas partially remediated and subject to the deed notice.

12.Section 1.4.1 should discuss all soils including the soil subject to deed notice.

13.Section 1.5 Contaminant Fate and Transport. There is no discussion about historical discharges to lined and unlined lagoons. These lagoons should be presented in the missing conceptual site model.

14.Section 1.6.1 Human Health Risk Assessment. This HHRA does not conclude that the soil within the containment area is below risk levels for construction workers as indicated in this section. Also conclusions in the HHRA are based on the existing deed notice. Any Institutional controls that will be part of the selected remedy should be presented in this FS. Please include all areas in the Section 2.1.1.

15.Section 1.6.3 Conclusions. The FS states "The human health risk assessment indicates the Property overall is suitable for industrial/commercial use." However that is based on deed restrictions being in place. Any Institutional controls should be presented in this FS.

16.Section 2.1.6.1 Human Health Remediation Goals. States "As discussed in **Subsection 1.6.1**, the BHHRA did not identify any carcinogenic risks associated with OU1 and OU2 above the CERCLA acceptable risk range of 10-4 to 10-6 or a non-cancer Hazard Index of 1." MassDEP disagrees with Section 1.6.1 because it leaves out soils in Lake Poly, the drum areas, containment area and Plant B. Section 2.3.2.3 says that institutional controls are needed for EA1, EA3, and EA7 however no details are provided.

17.Section 3.1 Selection of Remedial Alternatives. States "The USEPA-approved Final OU1/OU2 RI Report (USEPA, 2015) recommended installation of a permanent cap over the Slurry Wall and Containment Area structure to replace the current temporary cap. The objective is to replace the temporary cap over the Slurry Wall Containment Area with a permanent cap to continue to minimize infiltration into the Containment Structure. Placement of a permanent cap over the containment area is also a binding contractual requirement under the current Purchase and Sale Agreement that exists for sale of the property. Therefore, remedial alternatives will consist of installation of a permanent cap over the OU1 Slurry Wall Containment Area." The RI did not preclude looking at other actions in addition to capping as an alternative. Also, this FS should evaluate the effectiveness of installing a permanent cap before selecting it as an option.

18.ARAR tables have not been reviewed by MassDEP legal due to the extensive nature of the comments. However, State ARAR that appears to be missing are Upper Concentration Limits.

OU 3 Remedial Investigation

1.Page 1-4 There are several references to the work conducted under the MCP. Such as:

1. "closure of the lined lagoons and excavation of Lake Poly, which was a prominent disposal location that contributed to the formation of DAPL. Lake Poly was excavated to the full vertical extent of impacted soil and no indication of residual DAPL was identified there." This action was not a closure but a removal to abate a hazard.

2." All removal actions were conducted in accordance with the MCP"

3. Since 1997, Olin has operated the Plant B groundwater recovery/treatment system as an Immediate Response Action (IRA) under the MCP, and most recently, as an Interim Response Step, consistent with the Final IRSWP.

4. In 2000/2001, Olin constructed a Slurry Wall/Cap around the on-Property portion of the Upper DAPL Pool as a Release Abatement Measure (RAM) consistent with the MCP. Please note these areas never reached closure under the MCP and should be addressed in the FS for OU1 and OU2.

2.Page 1-16 Please provide more information on any soil contamination left in the drum storage area located to the west of Lake Poly. In particular, the area where drums were stored on this asphalt paved upland area.

3.Please provide more information on any soil contamination left in the *East and West Acid Pits*: Prior to 1964, the East and West Pits also received the Kempore process and acidic liquid wastes (Smith, 1997).

4.Section 2.1.2.5 Post Construction Monitoring Program for Containment Area. Please discuss the results here and indicate if results show contamination outside the Containment Area.

5.Page2-24 While The USEPA accepted Olin's recommendation of no further testing related to the slurry wall itself, that is not the case for requesting further evaluation if there is leakage between the wall and bedrock surface.

6.Section 2.2.7 Should include a reference to a figure showing the private well data and a 500 foot radius from their property.

7.Page 3-17 GW-1 Areas. It is obvious from the results that the contamination has traveled to the private wells. Therefore groundwater must be protective at least 500 feet away from property. Please provide a map showing the GW-1 areas and the areas that flow into them.

8.Page 4-2 identifies the current drinking water sources, however the potential drinking water source areas include all areas that flow into current drinking water areas.

9.Section 5.0 contaminant Fate and Transportation / Conceptual Site model. This section should include a figure showing the CSM including all soil contamination greater than 10 feet as stated will be included in this OU3 and vadose zone soil contamination.

OU3 Feasibility Study

1.MassDEP disapproves of this FS. The Remedial Action Objectives should not be to prevent exposure but should be to restore potable use and to remove DAPL not prevent exposure. Institutional controls are not appropriate remedial alternatives for GW-1 areas. Please resubmit with appropriate remedial alternatives to address groundwater contamination.

2.There is no indication that the Town does not want to use its wells again. The Town has written a letter stating such. This FS should be resubmitted with all the alternatives including the Town resuming pumping.

3.OU1 and OU2 RI and FS indicate that the OU3 would discuss soils greater than 10 feet below surface. Page 1.2 at the bottom onto next page says that these soils are discussed in OU1 and OU2. Please indicate where that is discussed.

4.Page 1-3 Please note that the Town has maintained these wells annually at expenses to them and plan on using them in the future.

5.Page 1-5 indicates that the lined lagoons were approved by MassDEP, please provide documentation of approval and any residual soil contamination results.

6.Are there any as built drawing of the containment wall?

7.Page 1-6 talks about a Post Construction Monitoring Plan, Is this part of a proposed alternative, if so which one.

8.Figure 1.4-1, 1.4-2, and 1.4.-3 do not show extent of contamination they show only above the a certain risk level.

9.Section 1.5 States "Currently, there are no leachable sources of contaminants in unsaturated soil that could result in the formation of a groundwater plume in overburden or bedrock. Former contaminant sources in unsaturated soils in OU1 (AMEC, 2015) have been investigated and addressed through response actions under the MCP." Which section of the RI discusses the leachable results.

10.Page 1-21 , first bullet, should be noted that the GW-1 areas also include 500 feet from the property and any groundwater flowing into that area needs to meet GW-1 standards.

11.Page 1-21 There are several statement made with no back up information provided, These include:

1.Bedrock underlying the DAPL pools and bedrock within the WBV under the region of diffuse groundwater have had long term impacts from high concentrations of NDMA. These areas are believed to contain a mass retained by matrix diffusion that is significant enough to render treatment of bedrock groundwater by extraction and treatment technically infeasible.

2. Future use of the Town wells will induce upward vertical gradients from underlying bedrock groundwater to deep overburden groundwater and therefore restoration of the MMB overburden aquifer to potable quality is not feasible in the foreseeable future.

3. DAPL extraction will not remove all DAPL. As extraction progresses, DAPL naturally becomes less dense and less concentrated as the top of the pool is drawn downward. This will limit the effectiveness of DAPL extraction by gravity drainage in the long run.

4. Extraction of DAPL will not result in attainment of groundwater restoration goals within a meaningful time frame.

12.Section 2.1 The Remedial Objective should not be to prevent exposure, it should be to restore. The DAPL RAO should be to remove not to prevent exposure.

13.This FS should evaluate pumping the DAPL from multiple extraction wells and at various rates. Not simply one well at 0.25 gallons per minute.

14.Alternative 4 No Action for Cook Ave is not appropriate because there is site related contamination above risk levels within 500 feet of the property.

15.Alternative 2 is not appropriate because MNA has not been shown to work and Institutional Controls in GW-1 areas are not remedial actions.

Please request that Olin address these comments and resubmit the above referenced documents.

Sincerely,

Garry Waldeck
MassDEP
BWSC

MEMORANDUM

Date: May 30, 2018

From: Wilmington Environmental Restoration Committee (WERC)

To: Jim DiLorenzo/EPA, Garry Waldeck/DEP

Re: WERC Comments on:
Results of Containment Area Bedrock Borings Memo
Olin Chemical Superfund Site - Wilmington, MA

WERC has completed a review of the Results of Containment Area Bedrock Borings Memo dated May 10, 2018. Like many previous documents for the site, numerous statements are made in the memo that are not supported by data or any technical analysis. WERC's comments focus on the larger issues for the site. It should not be construed that WERC agrees with statements in the document if not directly commented on.

Comments

1. Overall. Olin went forward with performing bedrock borings and preparing the memo without providing a work plan for review. As such, the submission of a work plan for the work should be included for review.

2. Page 1 Olin states the following:

   The borings corroborate the previous findings that bedrock underlying the Containment Area is highly competent and no additional investigation is warranted to verify the competency of the bedrock in the vicinity.

   As will be shown in following WERC comments, this statement is not correct and should be removed from the memo. What is more concerning is that Olin is willfully ignoring information to arrive at an answer they want. The memo does contain adequate information to evaluate the bedrock under the containment area and to determine the upper bedrock is not competent.

3. Page 2. Bedrock Boring Installation OC-BB-1-2018 Olin states the following:

   Bedrock was encountered at 27 feet below ground surface (bgs) and the augers were able to penetrate nearly two feet into weathered bedrock. A six-inch air hammer powered by a tow along compressor was then used to clean out the casing and create a socket into competent bedrock. Small potentially water-bearing fractures were encountered at approximately 32 and 35.5 feet bgs and a larger fracture was encountered at 40 feet bgs. The rock socket was terminated at 41 feet bgs. Four-inch flush jointed steel casing was installed to 41 feet bgs and tremie grouted in place.

   In the construction of well OCBB-1-2018, bedrock was encountered at 27 bgs but the steel casing was carried through to a depth of 41 bgs. So, the casing went through 14 feet of bedrock, before the rock was judged to be competent enough not to need a casing. The fourteen feet of casing went through weathered bedrock and several large and small water-bearing fractures.

Limited records exist on the construction of the slurry wall, but slurry walls are not keyed into bedrock to a depth of 14 feet. This boring log indicates the groundwater can easily flow under the slurry wall in the weathered and fractured upper layers of the bedrock.

4. Page 2 and 3. Bedrock Boring Installation: OC-BB-2-2018 Olin states the following:

   The overburden soils were composed of sand with large amounts of gravel and cobbles – however, auger refusal was encountered at approximately 17 feet bgs in what appeared to be cobbles and boulders that included weathered bedrock. The six-inch air hammer was then used to clean out the casing and attempt to drill to competent rock. The borehole was quickly advanced, through cobbles, boulders, till, and weathered bedrock, to approximately 27 feet bgs where competent bedrock was encountered. The borehole was advanced to 30 feet bgs. Repeated attempts to clean out the borehole to 30 feet were unsuccessful due to cave in of material and approximately 6 feet of material could not be removed from the bottom of the borehole. The four-inch steel casing was hammered to refusal at 28 feet, and grout was tremied into the borehole annulus to attempt to seal off the casing from the overburden.

   In the construction of well OC-BB-2-2018 boulders and weathered bedrock were encountered at 17 bgs but the steel casing was carried through to a depth of 30 bgs. So, for this well, the casing went through 13 feet of bedrock before the rock was judged to be competent not to need a casing. The construction of this well also included cave-in.

   Again, this is not how the slurry wall was constructed for the Containment Area. For both wells, over 10 feet of bedrock had to have steel casing. This indicates the groundwater can easily flow under the slurry wall in the weathered and fractured upper layers of the bedrock.

5. WERC's comments on the OU1 OU2 Feasibility Study provided an analysis of the water levels in and around the Containment Area. The analysis concluded the water level in the Containment Area has a consistent slope from north to south which reflects the groundwater outside the Containment Area. The Containment Area clearly is not functioning as designed. These findings indicate that a 'tilt' of the internal water contours is occurring due to the influence of the outside water table. The north side is higher, and the south side is lower in the internal water table. So, the containment area is not isolated from the outside. Flow is occurring into the area from the north and out of the containment area in the south. This well boring construction information in this memo indicates the flow may be through the weathered bedrock surface or through the bedrock fractures in the upper layers.

MEMORANDUM

Date: May 25, 2018

From: Wilmington Environmental Restoration Committee (WERC)

To: Jim DiLorenzo/EPA, Garry Waldeck/DEP

Re: WERC Comments on:
Draft OU1 & OU2 Feasibility Study Report
Olin Chemical Superfund Site - Wilmington, MA

WERC has completed a review of the Draft OU1 & OU2 Feasibility Study dated March 30, 2018. Like many previous documents for the site, numerous statements are made in the memorandum that are not supported by data or any technical analysis. WERC's comments focus on the larger issues for the site. It should not be construed that WERC agrees with statements in the document if not directly commented on.

Comments

1. Overall. The feasibility study for OU1 And OU2 presented in the report is incomplete and inadequate. Most technologies are quickly eliminated in the screening step and then, the few technologies remaining are grouped into few alternatives to provide a resemblance of choice. More technologies must be considered and carried further through the alternative evaluation in the revised report.

2. Containment Area: The Containment Area is not adequate and additional technologies must be included that address the soils and groundwater in the Containment Area.

3. Page 1-5 Olin states the following:

   • Monitoring water levels within the Containment Structure indicate horizontal hydraulic gradient within the structure is essentially flat.

   • Vertical gradients within the Containment Structure have also remained essentially neutral since 2001.

   • The equalization window is functioning as designed to relieve any buildup of hydraulic pressure inside the slurry wall.

   • The relatively flat internal gradients and lack of vertical gradients with the structure indicates the slurry wall is effectively isolating groundwater above the DAPL from groundwater outside the Containment Structure. Therefore, the Containment Structure is performing as designed as a source control measure for the on-Property DAPL Pool.

   A review of the water level data reveals that the above statements are not correct and should be removed from the report. Instead, the water level in the Containment Area has a consistent slope from north to south which reflects the groundwater outside the Containment Area. The Containment Area clearly is not functioning as designed.

Attached is **Appendix 1** to this comment memo which contains an analysis of the water levels in the Containment Area. Please review and include in a revised report.

4. Page 1-7/8 Olin states the following:

   The current impacts to EA5 soil are associated with historical releases to the ditch system and not ongoing discharge of dissolved constituents to surface water.

   Please provide evidence to support this statement in the revised report. The historic groundwater and surface water data in the area has not shown a decrease over time. Please provide evidence why groundwater will not have to be remediated to prevent future recontamination of EA5 sediment.

5. Preliminary Remediation Goals (PRGs) and Applicable or Relevant and Appropriate Requirements (ARARs). However, some issues are noted.

   a. Page 2-8: For the South Stream Surface Water states a PRG for HQ=1 for Chromium of 0.46 mg/l. There is an AWQC for Chromium VI which should also be used. The chronic criteria for Chromium VI is 0.011 mg/l or (11 ug/l).

   b. Page 2-9: For the South Stream Surface Water, Note [b] states: *The ammonia PRG is based on the freshwater chronic ambient water quality criterion (AWQC) in USEPA 2013 using a default pH of 7 and assuming that salmonid fish are absent as explained in the BERA.* That is not how the AWQC is applied. Representative species are tested and used to develop the criteria. One doesn't choose which species are or are not present and then further adjust the criteria. The chronic concentration for ammonia should be around 1.9 mg/l for a pH of 7 and temperature of 20^{o} C. This is the criteria value used for cleanup at the Halls Brook Holding Area Pond for Industrial Plex Superfund site. The report should be modified and include the actual AWQC for ammonia.

   c. Please provide a figure indicating the respective groundwater areas that provide flow to the South Stream and EA5. For each, the contributing groundwater area, and indicate the concentrations of ammonia and chromium in these areas. A basic conceptual model of the groundwater flow area for both South Stream and EA5 must be developed to determine the groundwater areas that must be addressed.

   Page 2-10 Sediment. Olin fails to recognize or evaluate the recontamination of sediment from groundwater. Analysis must be provided that evaluates sediment recontamination from groundwater. Chromium, which is high in groundwater and surface water, is expected to recontaminate the sediment.

6. Page 2-10: Slurry Wall Containment Area: The report is prepared with the presumption that the Containment Area is adequate and only needs a permanent cap. This is not correct. As WERC has noted several times, the groundwater in the containment area migrates through the bedrock fractures and impacts the South Stream. Additional assessments and controls must be considered for the material in the containment area and included in a revised report.

7. Page 2-13: TMP in EA1, EA3, and EA7. The discussion for mitigating the health risk for TMP is only discussed briefly and then dropped. This alternative needs a complete discussion and carried through all alternatives. Present and layout alternatives that prevent vapor intrusion.

8. Page 2-13 Surface Water Technology Screening Summary: All technologies are dismissed and assessment of active remedies for surface water is deferred to the OU3 groundwater FS. Groundwater control/treatment is a viable option, alternatives, such as treatment of ammonia and chromium in the surface water must also be considered and included in this FS.

Appendix 1

Containment Area and Slurry Wall

1. Groundwater Flow Patterns and Gradients:

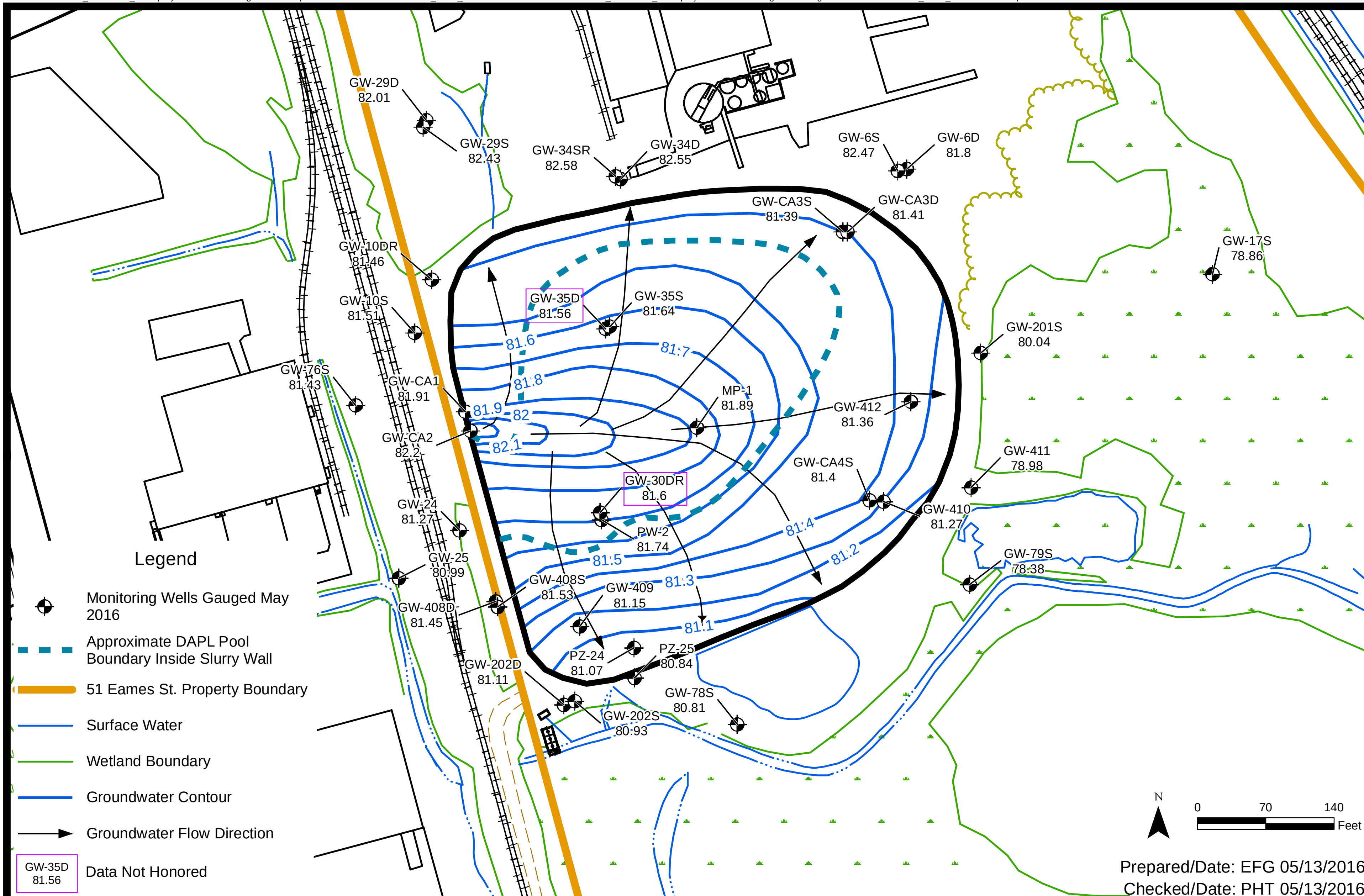
   The slurry wall of the containment area is intended to fully isolate the outside groundwater from the internal groundwater except through the equalization window. At the equalization window, flow can enter or exit the containment area depending on the flow gradients at the time. If the water surface is higher just outside the equalization window, flow is into the containment area. If the water surface just outside the window is lower, flow is out of the containment area. Overall, in Wilmington high groundwater is generally around May 1 and low groundwater around October 1 every year. One would expect that during the rising groundwater time (October through May) that groundwater flows into the containment area via the equalization window. During lowering groundwater time (May through October) flow would be out of the equalization window. Roughly, one would also expect as much flow to exit the containment area as flowed in during the previous time period, but variations will occur on wet and dry years. This can be visualized by a simple groundwater signal that increases part of the year and flow goes into the containment area, and then signal decreases and flow goes out of the containment area.

   Within the containment area, if fully isolated from the outside water surface elevations, water surface contours should be semi-circles or semi-ellipses around the equalization window. Simply, a mound of water is spreading out away from the equalization window. Figure 11 (attached) of Olin's HPIT Phase II report presents this case for May 6, 2016 high groundwater condition. The groundwater elevations are a series of semi-ellipses contours around the equalization window. Conversely, a similar figure in October for low groundwater would have similar ellipses, but the lowest contour would be at the window and increasing elevation contours of semi-ellipses away from the window. Again, if the slurry wall is functioning as intended, points equi-distant north and south from the equalization window would have the same water surface elevation in the containment area.

   However, a review of the figures contained Appendix E of the HPIT Phase II Report indicate a very different condition is occurring. Attached are the figures with flow lines added to indicate flow direction on each figure. Flow directions should be either away from the equalization window or to the window. However, that is not the case. The flow direction is more often a north to south direction, much like the outside flow field. Of note, at PZ-24 in the southwest corner of the containment area always has the lowest water surface elevation and GW-CA3S has the highest most of the time. Clearly, the outside flow field is strongly influencing the water surface elevations in the containment area.

To further examine the water surface elevation data, the data from Appendix E of the HPIT Phase II Report figures were entered into a spreadsheet and plots made between two well points. A figure is attached the presents the data selected plots. For example, GW-CA1 (at the window) is always higher than PZ-24 (the southwest corner of the containment area). Always higher! This indicates that flow is <u>always</u> going from GW-CA1 to PZ-24. The only place for the flow to go at PZ-24 is through (or under) the slurry wall. Similarly, either there is no flow or flow is going from GW-CA3S (northeast corner of containment area) to GW-35S (center portion containment area) 8 out of 9 times. Clearly, GW-35S being nearer the window should be higher part of the year than GW-CA3S. Again, there must be an additional flow source besides the window. Groundwater flow is occurring either through (or under) the north slurry wall. These findings indicate that a 'tilt' of the internal water contours is occurring due to the influence of the outside water table. The north side is higher and the south side is lower in the internal water table. So, the containment area is not isolated from the outside. Flow is occurring into the area from the north and out of the containment area in the south. The route of the flow is not known. The flow could be through the slurry wall, through the slurry wall and bedrock interface, through the weathered bedrock surface or through the bedrock fractures.

Document: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\MapDocuments\RI Work Plan\Olin_HPIT_GW-Elevations.mxd PDF: P:\old_Wakefield_Data\projects\OLIN\Wilmington\GIS\Figures\RI Work Plan\Olin_HPIT_GW-Elevations.pdf

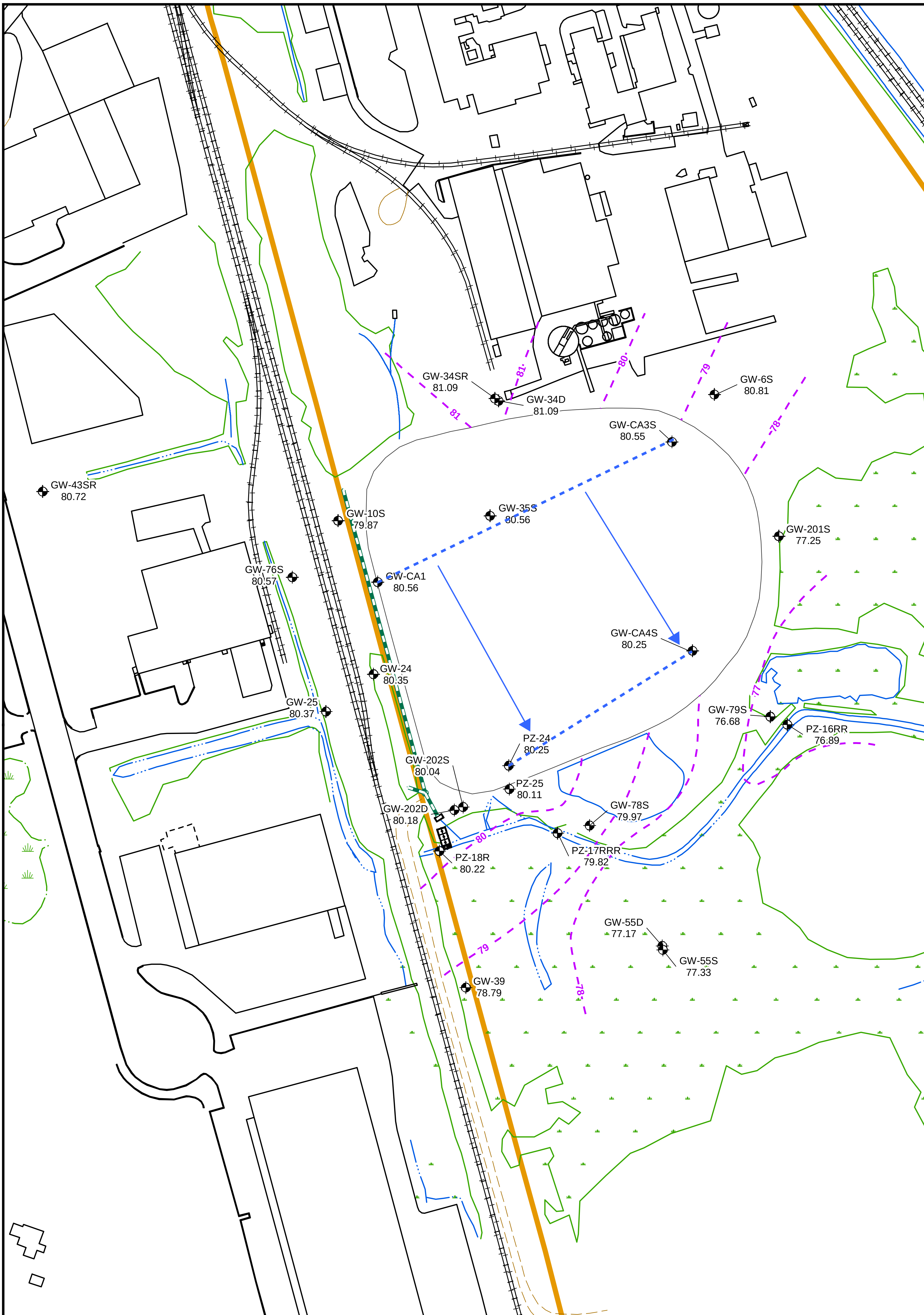


Prepared/Date: EFG 05/13/2016
Checked/Date: PHT 05/13/2016

Olin Chemical Superfund Site
Wilmington, Massachusetts

amec foster wheeler

Figure 11 - Interpreted Groundwater Contours Inside Slurry Wall
May 6, 2016



Legend

- Monitoring Well Location
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

amec foster wheeler

Amec Foster Wheeler
Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120 240
Feet

Figure E-1
Slurry Wall / Cap Interpreted Water Level Contours - Third Quarter 2015
August 8, 2015
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16

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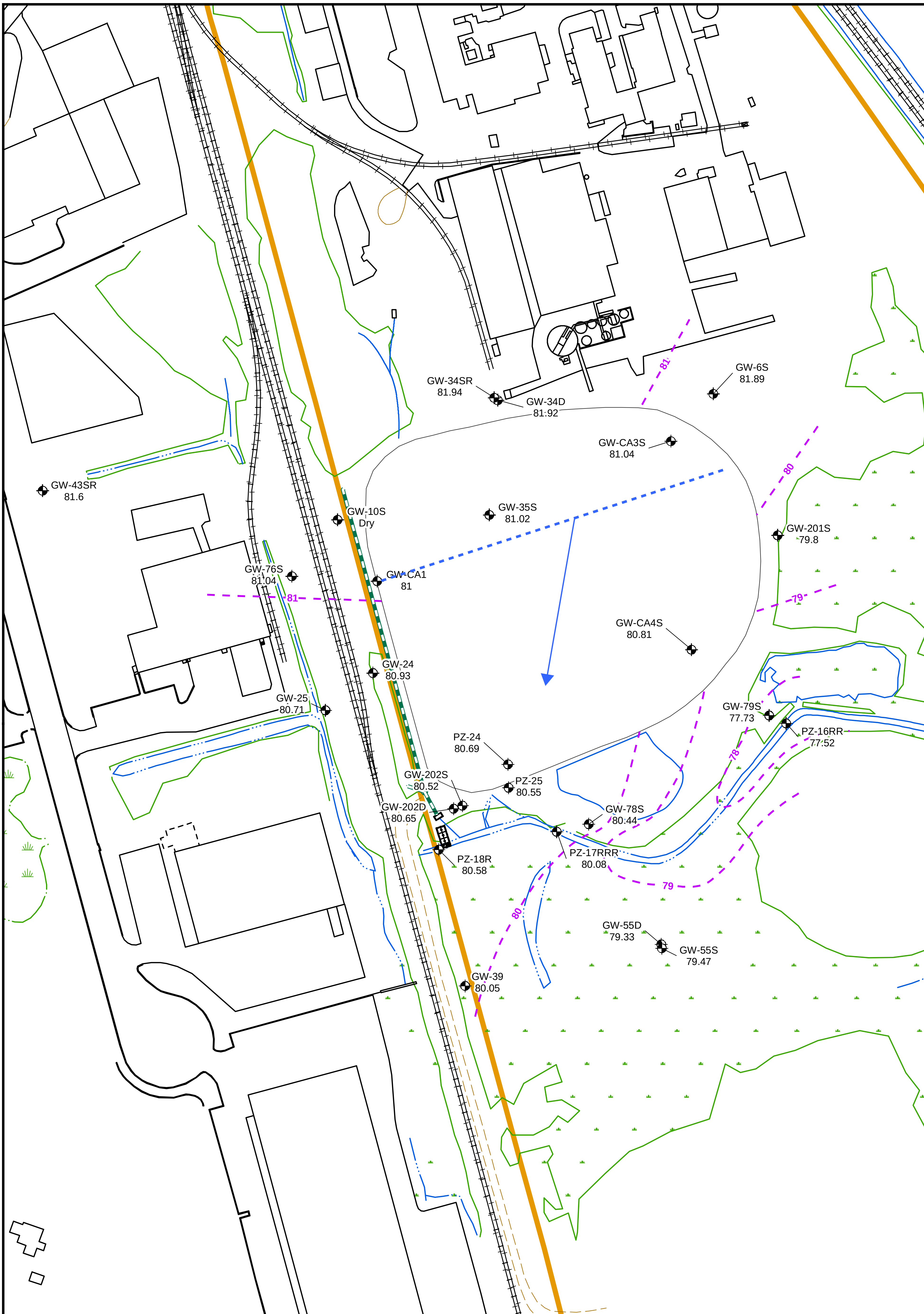


Legend

- Monitoring Well Location
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

amec foster wheeler

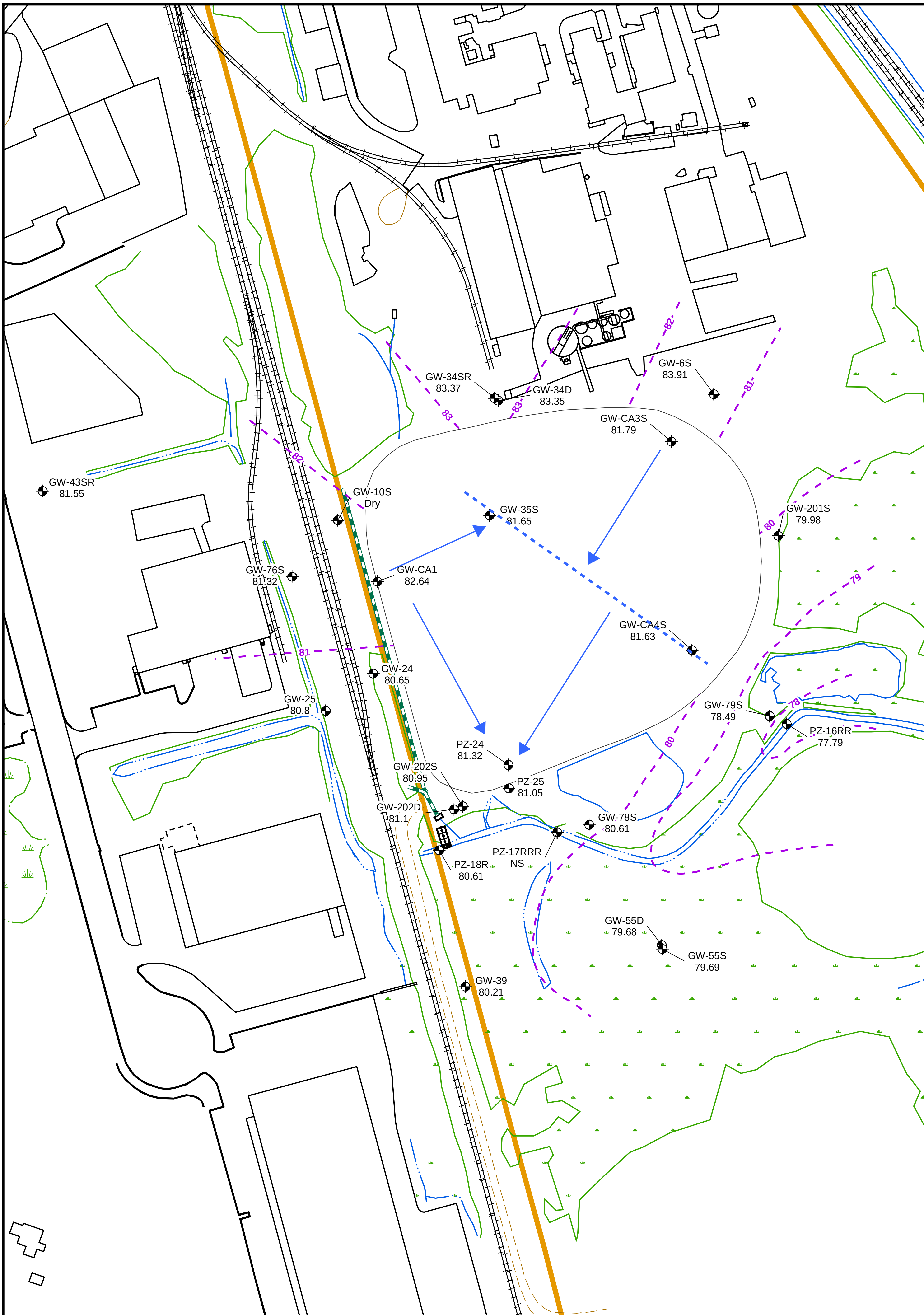
Amec Foster Wheeler
Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120 240 Feet

Figure E-2
Slurry Wall / Cap Interpreted Water Level Contours - Second Quarter 2015
May 28, 2015
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16



Legend

- Monitoring Well Location
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

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Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120 240
Feet

Figure E-3
Slurry Wall / Cap Interpreted Water Level Contours - First Quarter 2015
April 8, 2015
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16

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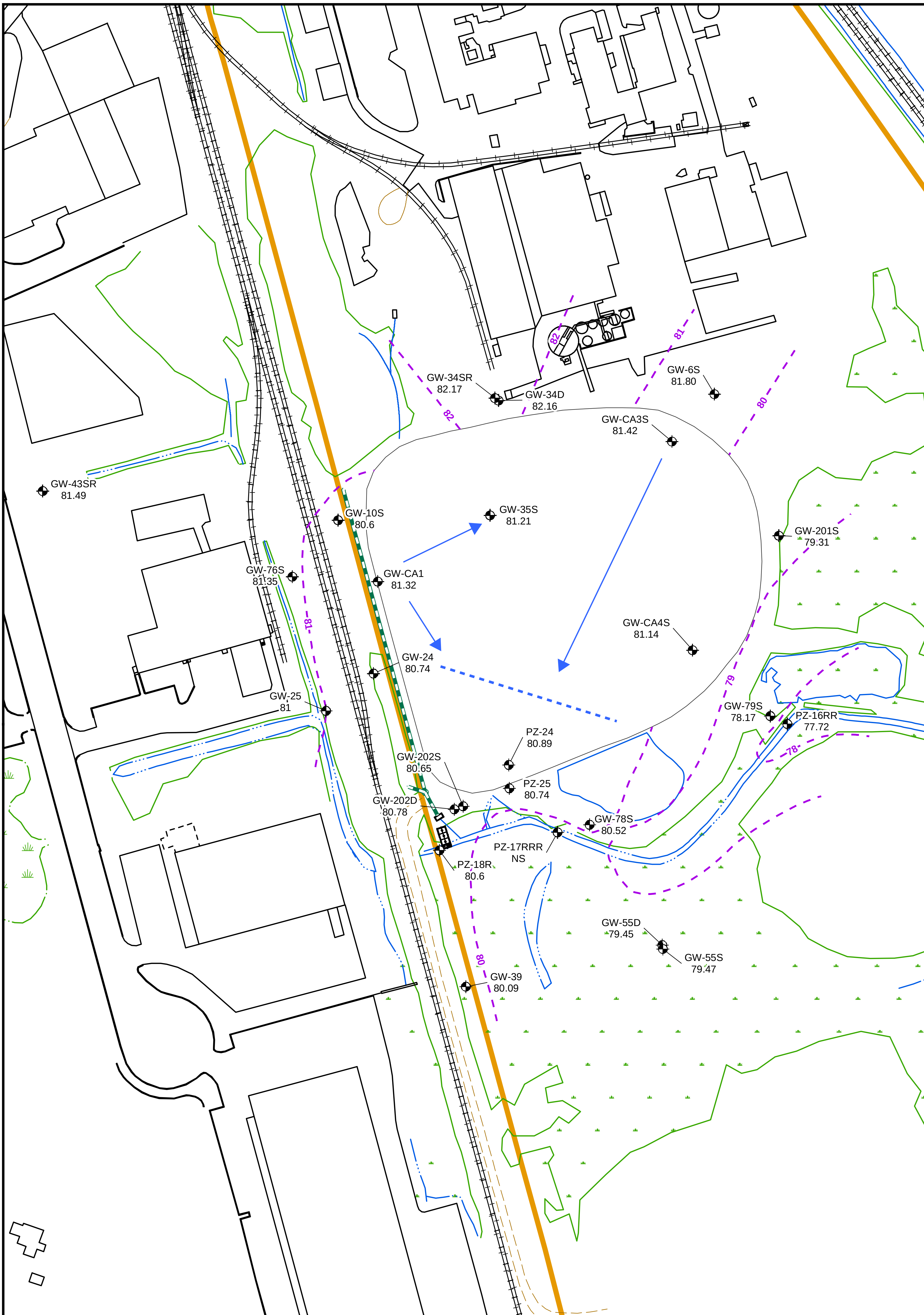

Legend

- Monitoring Well Location
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

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Chelmsford, MA 01824

N

0 60 120 240 Feet

Figure E-4
Slurry Wall / Cap Interpreted Water Level Contours - Fourth Quarter 2014
November 6, 2014
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16

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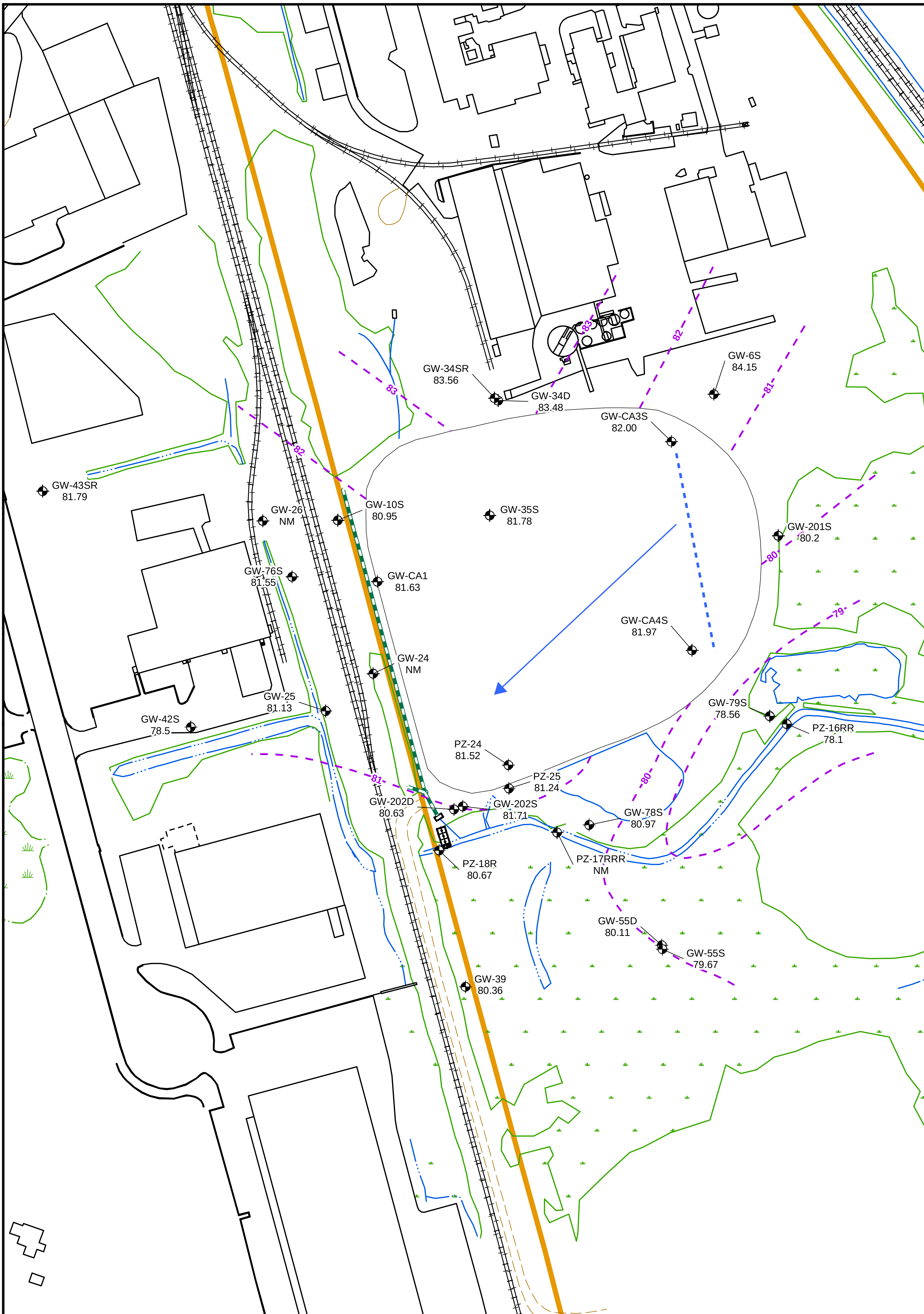

Legend

Monitoring Well Location	Paved Road	Water
Interpreted Groundwater Contour	Unpaved Road	Culvert
Site Boundary	Railroad	Trail
Wetland Boundary	Structure	

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Environment & Infrastructure
271 Mill Road
Chelmsford, MA 01824

N

0 60 120 240
Feet

Figure E-5
Slurry Wall / Cap Interpreted Water Level Contours - First Quarter 2014
April 4, 2014
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16

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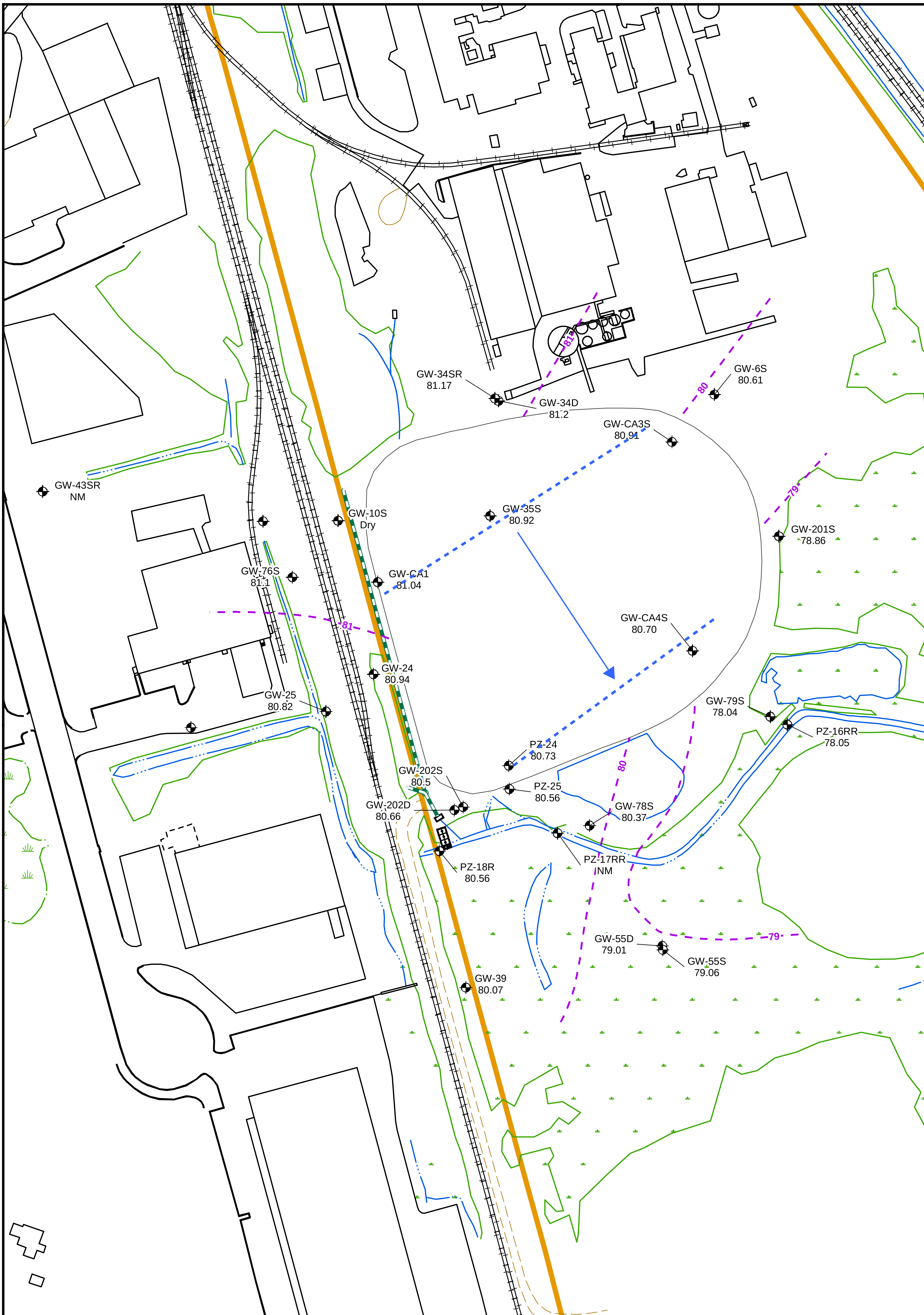

Legend

- Monitoring Well Location
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

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Chelmsford, MA 01824

N

0 60 120 240 Feet

Figure E-6
Slurry Wall / Cap Interpreted Water Level Contours - Fourth Quarter 2013
December 3, 2013
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16	Checked/Date: PHT 06/29/16

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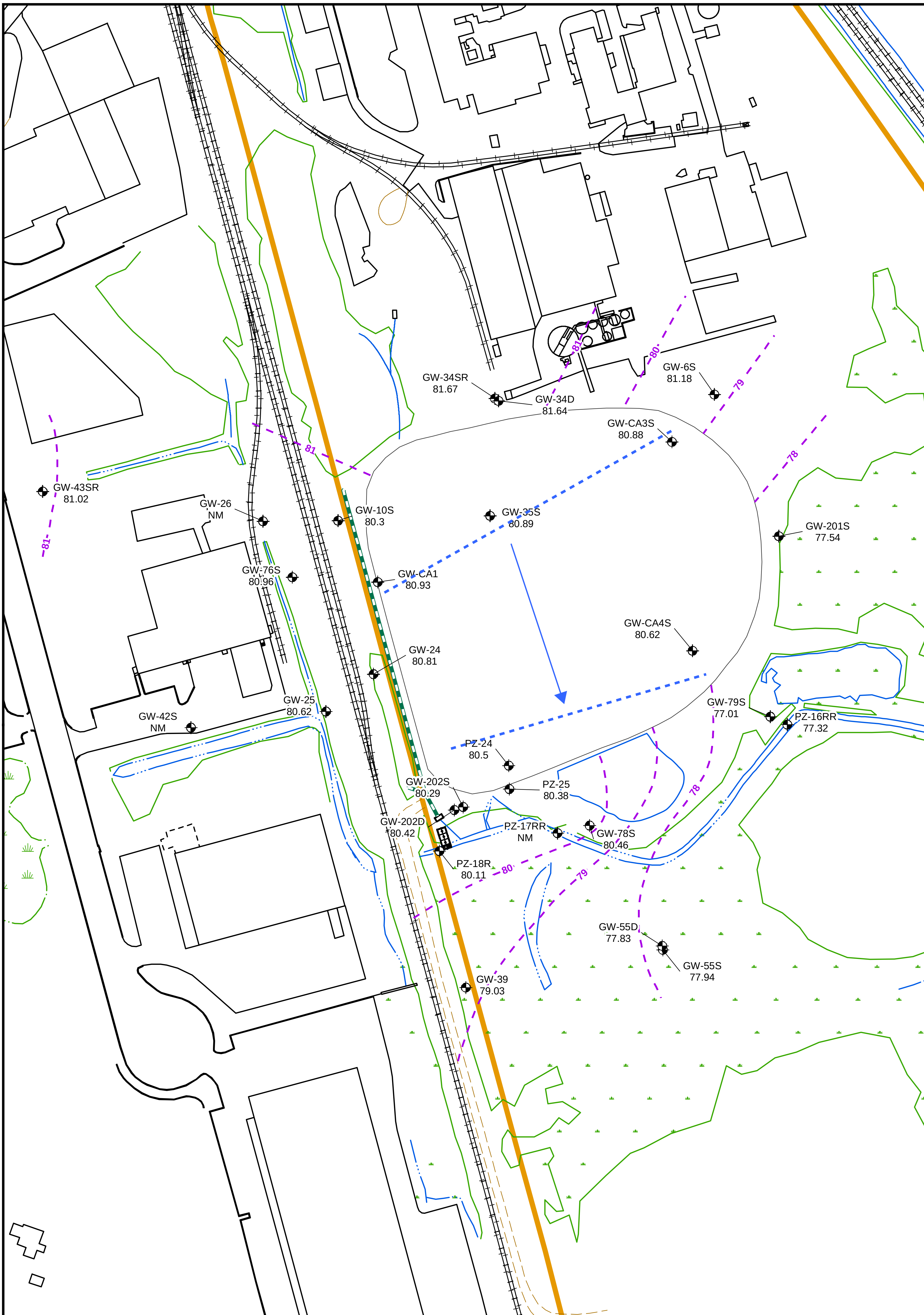

Legend

- Monitoring Well Locations
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

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Amec Foster Wheeler
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Chelmsford, MA 01824

N

0 60 120 240
Feet

Figure E-7
Slurry Wall / Cap Interpreted Water Level Contours - Third Quarter 2013
August 22, 2013
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16

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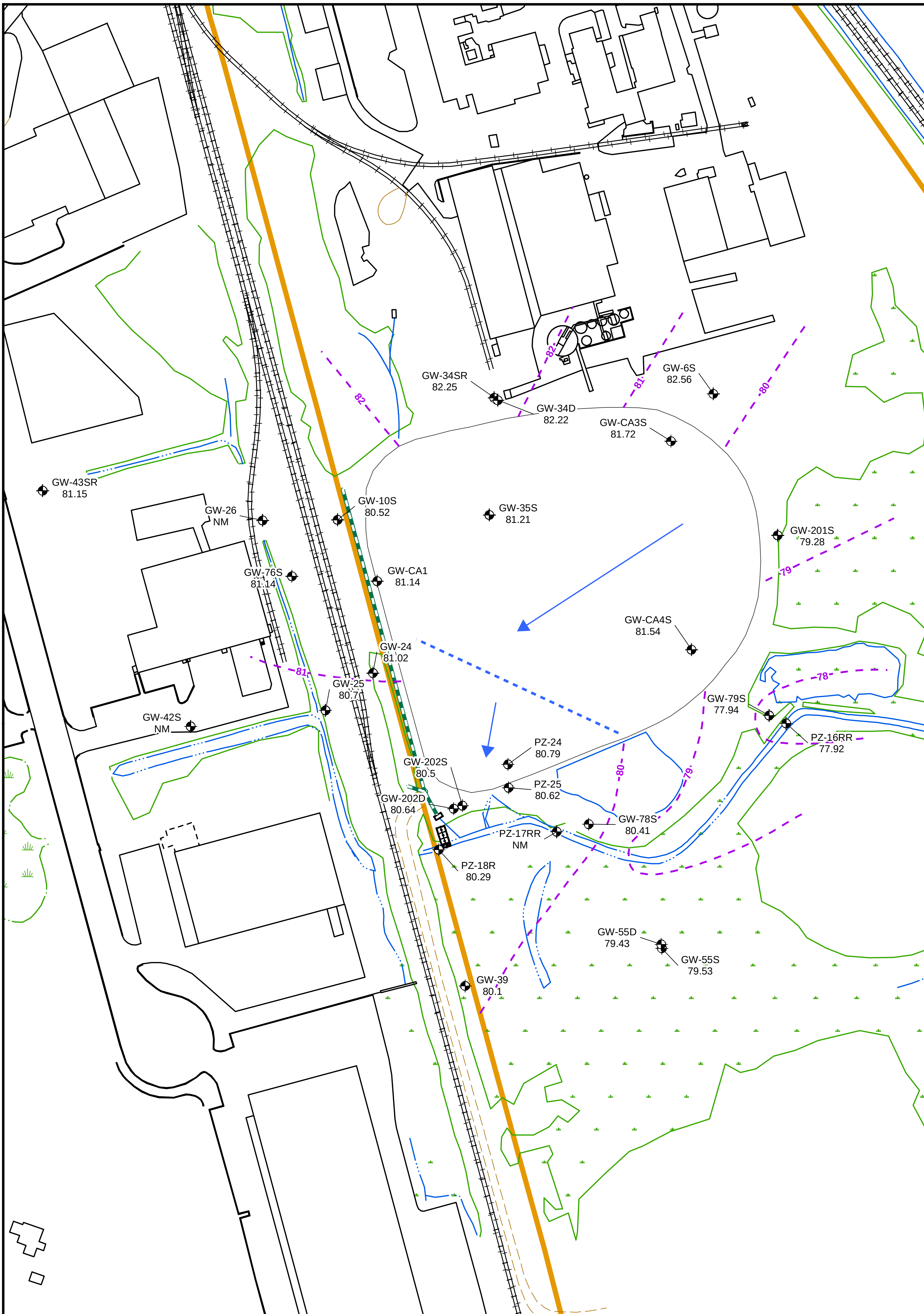

Legend

- Monitoring Well Locations
- Interpreted Groundwater Contour
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

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N

0 60 120 240
Feet

Figure E-8
Slurry Wall / Cap Interpreted Water Level Contours - Second Quarter 2013
May 6, 2013
Supplemental HPIT Memorandum
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: EFG 06/29/16 | Checked/Date: PHT 06/29/16

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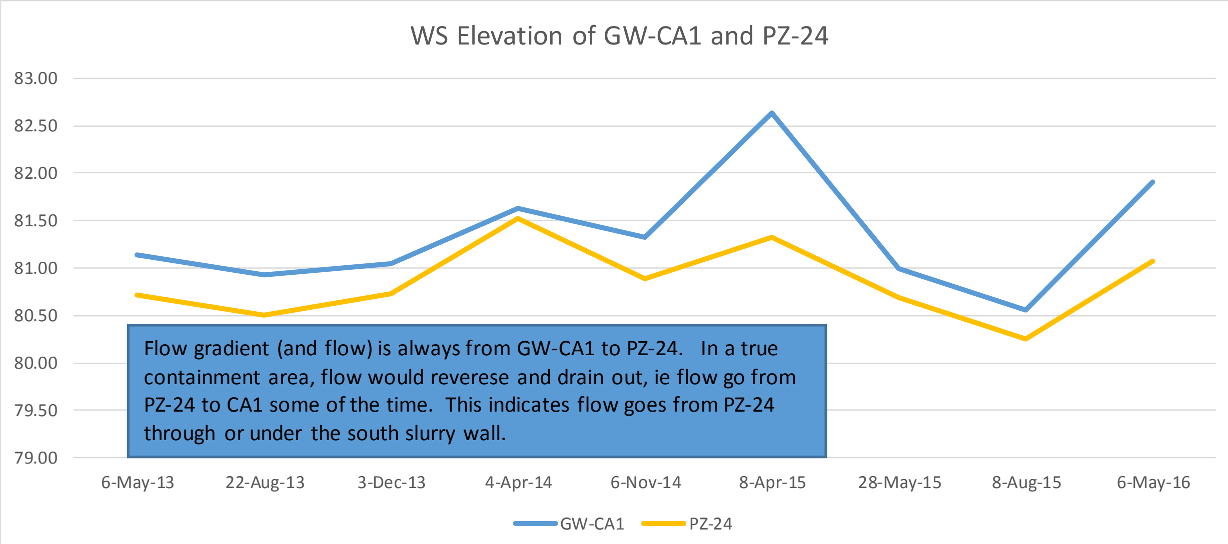
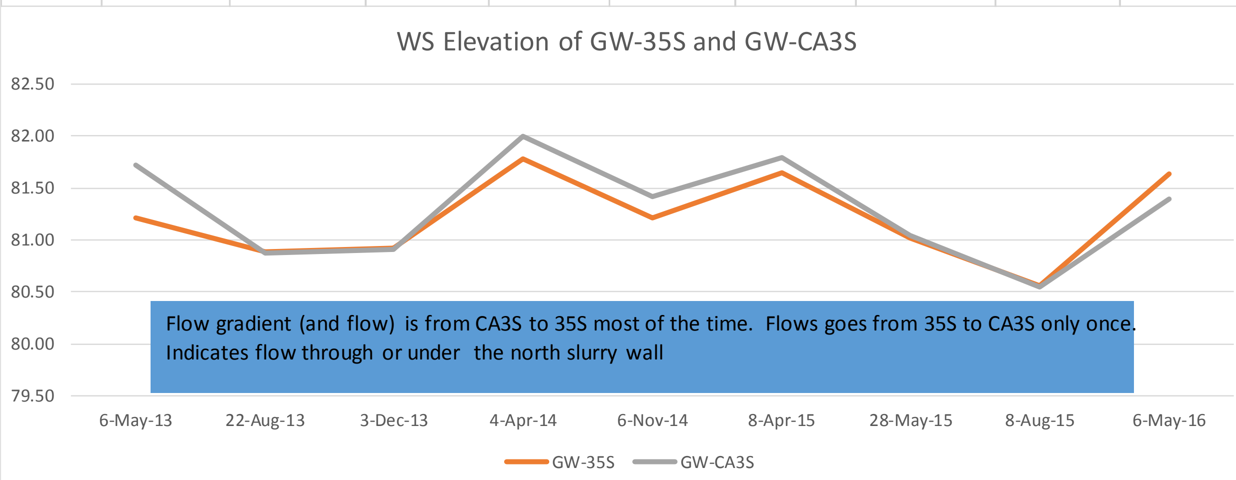
Olin site

Containment Area WS Elevation

Well	6-May-13	22-Aug-13	3-Dec-13	4-Apr-14	6-Nov-14	8-Apr-15	28-May-15	8-Aug-15	6-May-16
GW-CA1	81.14	80.93	81.04	81.63	81.32	82.64	81.00	80.56	81.91
GW-35S	81.21	80.89	80.92	81.78	81.21	81.65	81.02	80.56	81.64
GW-CA3S	81.72	80.88	80.91	82.00	81.42	81.79	81.04	80.55	81.39
PZ-24	80.72	80.50	80.73	81.52	80.89	81.32	80.69	80.25	81.07
GW-CA4S	81.54	80.62	80.70	81.97	81.14	81.63	80.81	80.25	81.40





Note: High groundwater is around May 1 and low groundwater around October 1 every year. Expect that during the rising groundwater time (October through May) that groundwater flows into the containment area via the equalization window and GW-CA1 would be higher than other internal water levels. During lowering groundwater time (May through October) flow would be out of the equalization window and and GW-CA1 would be lower than other internal water levels.

MEMORANDUM

Date: May 25, 2018

From: Wilmington Environmental Restoration Committee (WERC)

To: Jim DiLorenzo/EPA, Garry Waldeck/DEP

Re: WERC Comments on:
Draft OU3 Feasibility Study
Olin Chemical Superfund Site - Wilmington, MA

WERC has completed a review of the Draft OU3 Feasibility Study dated March 30, 2018. The FS Report does not present and evaluate sufficient alternatives to be considered adequate. Also, like many previous documents for the site, numerous statements are made in the report that are not supported by data or any technical analysis. WERC's comments focus on the larger issues for the site. It should not be construed that WERC agrees with statements in the document if not directly commented on.

Comments

1. Page ES-1. Olin states the RAO for OU3:

   For overburden and bedrock groundwater within Zone II of the Municipal Water Supply Wells (MWSWs) in the Ipswich watershed and the zone of contribution to two residential wells on Cook Avenue in the Aberjona watershed: prevent exposure via potable use to constituents of concern at concentrations that are 1) associated with cancer risk greater than 1x10-4 and/or hazard Index greater than one, and 2) above drinking water Maximum Contaminant Levels.

   Prevent exposure to DAPL.

   Reduce, to the extent practicable, mobility or volume of DAPL constituents in the DAPL pools that present a source of long-term impacts to groundwater and surface water

   These RAOs fail to recognize the value of the aquifer for private and public water supply and DEP designation and must be changed.

   CERCLA states in 40 CFR 300.430 that "The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." It further states that expectations when developing appropriate remedial alternatives include: "(A) EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials. And "(F) EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site."

The heavily contaminated "DAPL" is liquid, and contains high concentrations of toxic compounds and highly mobile NDMA. The beneficial use of this ground water is as a drinking water aquifer, and this must be the goal.

In addition, if clean-up is not feasible, EPA expects to "**prevent** further migration of the plume," not to just ***Reduce****, to the extent practicable, mobility or volume…* as Olin proposes. (emphasis added)

A more appropriate RAO would be:

Restore ground water aquifers to pre-disposal/pre-release conditions, to the extent practicable.

2. Page 1-5 Olin states:

   a trench was excavated into bedrock until refusal and kept open by a bentonite slurry during excavation. The alignment borings were initial targets for depth to bedrock; however, where weathered bedrock was encountered at excavation, several additional feet of bedrock were typically excavated to ensure the slurry wall connected to more competent bedrock.

   Our understanding is that the trench was excavated to a depth of boulders and weathered bedrock, not "into bedrock" and that the slurry wall was not connected uniformly to competent bedrock. Please provide documentation, including site records and photographs, from the slurry wall construction to support these claims.

3. Page 1-6 Olin states:

   Water levels monitored within the Containment Area indicate that the horizontal hydraulic gradient within the Containment Area is essentially flat; and

   The relatively flat internal gradients and lack of vertical gradients with the structure indicate the slurry wall is effectively isolating groundwater above the DAPL from groundwater outside the Containment Area.

   Both of these statements are <u>not</u> correct. The water levels inside the containment area are not "essentially flat" and the containment area is not "effectively isolating groundwater". An analysis (submitted in WERC comments on OU1 & OU2 FS Report) indicates the water levels have a north-to-south slope which indicates the containment area is not functioning as intended. Alternatives must be developed to address the groundwater in the Containment Area.

4. Page 1-7 Olin fails to include Aberjona watershed in the BHHRA (except for private wells on Cook Avenue) or to include any alternatives.

5. Page 1-8 Olin states:

   Other risk contributors that are not associated with the releases from the OCSS include 1,2-dichloroethane (1,2-DCA), benzene, cis-1,2-dichloroethene (cis-1,2-DCE), *naphthalene, trichloroethene (TCE), and vinyl chloride (VC).*

Please provide documentation regarding why these commonly used chemicals would not have been used or present as contaminants at this facility.

6. Page 1-8 Olin states:

   Groundwater impacts in the MMB aquifer are primarily deep, occurring in the deep overburden and underlying bedrock.

   While it is correct that NDMA and other the constituents of concern generally are higher deeper in the overburden, NDMA concentrations are high in most of the overburden. Olin tries to imply that the problem is deep, it is not. Olin fails to provide figures that indicate the extent of the vertical contamination. Just addressing the "DAPL" is not adequate, the larger plume of NDMA extends well above the limits of the "DAPL" and "diffuse layer" as defined by Olin. Please delete or reword the statement.

7. Page 1-11 Olin says the source of NDMA at the private wells is on-site grey-water (septic systems). As WERC has noted in our comments on OU3 RI, this is laughable. Cook Avenue homes have similar NDMA values as others in the area, but Olin admits to being the source for their NDMA. Olin has failed to adequately examine or understand the transport of NDMA and other constituents through the bedrock fractures. Please provide additional supporting information or delete the statement.

8. Page 1-11 As WERC commented in numerous previous reports, it is not clear how "DAPL" is defined. Is the "DAPL" defined by specific conductance or by the presence of ammonia, chloride magnesium, sodium, sulfate above their respective threshold values in the equation or is it above a specific gravity of 1.025? The definition needs to be updated and validated using the additional monitoring data collected. Does the method still work? Please include an updated analysis in the revised document.

9. Page 1-12 Olin states:

   NDMA has been detected in DAPL, and the highest concentrations of NDMA detected at the OCSS occur in DAPL. Detected concentrations of NDMA in DAPL range from 120 to 64,000 ng/L. The NDMA formation mechanism at the OCSS has not been identified. NDMA was not used or manufactured at the OCSS during historic operation. Olin consulted Dr. William Mitch, an expert who has published extensively concerning NDMA formation from precursors in wastewaters and disinfected drinking waters. Under his direction, a precursor protocol test was conducted to determine whether addition of precursors at high molar ratios to OCSS DAPL or diffuse groundwater would result in formation of NDMA. Laboratory deionized water was used as the control media. The addition of precursors resulted in NDMA formation in the control samples, but not in DAPL or diffuse groundwater. Dr. Mitch concluded, based on the site-specific information, that the concentrations of NDMA in DAPL did not increase, lending support to a conclusion that <u>NDMA is not being formed in DAPL or diffuse groundwater, either currently or in the past</u>. Since the conditions of the historical chemical manufacturing processes and operations at the facility cannot be replicated, the mechanism for NDMA formation from the historical operations/processes cannot be confirmed. Whether NDMA *was a potential contaminant in other feed stock chemicals used in manufacturing is also not known.*

Please provide more details on the precursor protocol test for review. Also, is Olin stating (as underlined above) that NDMA is and was not formed in the DAPL or diffuse groundwater? Then, where was it formed? Please provide the source of the NDMA if is not the DAPL or diffuse groundwater.

10. Page 1-14. Olin states the following:

    The fractured bedrock underlying DAPL pools and in contact with high concentrations of dissolved constituents, NDMA in particular, will be subject to matrix diffusion adjacent to impacted fractures. Over a period of many decades the process of matrix diffusion coupled with matrix advection results an environmentally significant amount of mass being transferred to the bedrock matrix that will act as long-term source to groundwater.

    Olin has not provided any data or information to support these statements. Please provide supporting information.

11. Page 1-15. BHHRA needs to be performed for the Aberjona watershed. Please provide this information in the revised report.

12. Page 1-17 Olin states:

    Within the Aberjona watershed, there is substantial interaction between impacted groundwater along the entire length of South Ditch, and to a lesser extent within the off-PWD, which is the headwater to the South Ditch.

    Two comments on this statement. Olin fails to include groundwater abatement alternatives in the OU3 FS to address the South Stream surface water issues with ammonia and chromium. Please add alternatives to the revised report. Just removing the Jewel Street DAPL will not be adequate to attain surface water quality standards for the stream. The "diffuse material" plume, as indicated in Figure 1.4-2, also needs to be addressed. Additionally, besides removing sediment in the South Stream and EA5, the groundwater will need to be addressed to prevent re-contamination of the sediment.

13. Page 1-18 Provide figures (plans and profiles) for all contaminants listed below to define the extent of the problem in the revised report.

    Core of the Ipswich Overburden Plume: NDMA, biphenyl, chloroform antimony, arsenic, cobalt, iron, manganese, nickel, and vanadium

    Core of the Ipswich Bedrock Plume: NDMA, 2,4,4-Trimethyl-1-pentene, chloroform, hydrazine, antimony, arsenic, cobalt, iron, manganese, nickel and vanadium.

14. Page 1-21 Olin fails to include treatment alternatives of the large diffuse NDMA plume. Though DAPL removal needs to be done, only looking at treatment of NDMA at the town wells is not adequate. Please provide treatment alternatives for the above listed

contaminants as well as ammonia in the revised report.

15. Page 2-1 As noted above the RAOs are not adequate. See comment #1.

16. Page 2-7 Treatment alternatives should be included for all the COC, not just NDMA. Please provide treatment alternatives in the revised report. At a minimum, include available technologies based on UV irradiation (including pulsed UV and pulsed-UV/hydrogen peroxide), adsorption technologies (including GAC and zeolites), and biological methods (including fluidized bed bioreactor, propane biosparging).

17. Section 3 and Section 4 The Development and Screening of Alternatives (Section 3) Detailed Analysis of Alternatives is inadequate and should be rejected.

    Olin doesn't include a range of technologies to address all the risks. Olin then screens and eliminates most technologies prematurely. Lastly, Olin arbitrarily separates the few technologies that survive the screening into alternatives to make it appear they are evaluating alternatives. But the alternatives are either do nothing or slight variations on the same technology, in an attempt to make it appear as if several alternatives are being evaluated.. Please provide an adequate list of alternatives and carry the analysis for the alternatives forward to address the MMB and Aberjona watersheds.

18. Section 5 Recommended Alternatives Olin states:

    Based on the presumption the Town of Wilmington may not elect to re-activate their former MWSWs in MMB, Alternative 2 would be the preferred alternative as it meets the criteria for overall protection of human health and the environment, complies with ARARs, is effective in short- and long-term, reduces volume, and is straightforward to implement with proven technologies.

    For the Cook Avenue area, Alternative 4 would be the preferred alternative as, at this time, risk identified in the Cook Avenue area does not exceed the USEPA threshold cancer risk of 1x10-4 or hazard index greater than 1.

    These recommendations would be laughable if the issues weren't as serious as they are. Olin must re-consider their presumption; consider the Town of Wilmington elects to re-activate their wells. Also, given the variable concentrations of NDMA measured at private wells over the last several years, the assumption must be that at some time in the future risk levels will be exceeded. The preferable alternative fund the construction of a water line for the homes on private wells on Cook Avenue.

MEMORANDUM

Date: May 25, 2018

From: Wilmington Environmental Restoration Committee (WERC)

To: Jim DiLorenzo/EPA, Garry Waldeck/DEP

Re: WERC Comments on:
Draft Remedial Investigation Report OU3
Olin Chemical Superfund Site - Wilmington, MA

WERC has completed a review of the Draft Remedial Investigations Report OU3 dated March 30, 2018. WERC and other's comments on previous reports were to be addressed in this RI report. Instead, the RI presents little comprehensive understanding and continues a simplistic understanding of the site and its impact. Like many previous documents for the site, numerous statements are made in the report that are not supported by data or any technical analysis. It appears that Olin (and their consultant) continues to choose which data to use and which data to ignore to gain their 'view' of the site.

WERC comments focus on the larger issues for the site. It should not be construed that WERC agrees with statements in the document if not commented on.

Comments

1. Page 1-10 DAPL: Several comments on the "DAPL" equation/definition. The equations should be updated to determine if it is still accurate for defining DAPL. The base equation/definition is as follows:

   The definition of DAPL is based on having a specific gravity greater than 1.025 which can be estimated by an empirical relationship of its primary constituents, and by threshold concentrations, as follows:

   - *Ammonia concentration greater than 1,250 milligrams per liter (mg/L);*
   - *Chloride concentration greater than 2,800 mg/L;*
   - *Magnesium concentration greater than 270 mg/L;*
   - *Sodium concentration greater than 1,700 mg/L;*
   - *Sulfate concentration greater than 16,000 mg/L; and*
   - *Specific conductance greater than 20,600 micro-ohms per centimeter (µmhos/cm).*

   The equation for Specific Gravity (SG) is:

   SG = 2.6 x 10-7 x SO42- + 1.3 x 10-6 x Na+ + 3.7 x 10-6 x Cl- + 7.4 x 10-7 x NH3 + 1.01

   Comments:

a. This analysis was completed in 1999 by Geomega. It should be updated using the data collected since then to see if the analysis is still a reasonable predictor. For example, Olin uses Specific Conductance greater than 20,600 umhos/cm to determine the top of the DAPL. Is this still true? Include an updated analysis in the revised report.

b. The equation indicates that the Specific Gravity would increase with an increase in ammonia, however, ammonia has a density less than 1, and an increase in ammonia will decrease, not increase SG.

c. The Report states that NDMA concentrations in DAPL overlap with those found in overlying diffuse groundwater and therefore the concentration is not a reliable indicator of DAPL. Please include this analysis in the revised report.

d. Though not noted, WERC suspects SG of 1.025 was selected to define the DAPL, because marine water has an SG of 1.025 also. Clearly, a different SG could have been selected, such as 1.01 and a thicker "DAPL" would be defined. Include detailed analysis of the selection of 1.025 and why this represented a "statistically distinguishable population compared to the groundwater samples from diffuse/ambient groundwater" (p. 2-13) in the revised report.

e. A better definition/equation of "DAPL" would include pH. pH controls the "plugging" by precipitates of the soil and is a key parameter for pumping the DAPL. Please provide the relationship between ph on the 'DAPL' parameters in the revised report.

f. Vertical profiles of each parameter in the "DAPL" should be provided. Profiles would include where available, bedrock, "DAPL", Diffuse Layer" and a remainder of the groundwater. Please include the profiles in the revised report.

2. Page 1-11 The Report states that:

   NDMA concentrations in DAPL overlap with those found in overlying diffuse groundwater and therefore the concentration is not a reliable indicator of DAPL.

   Please provide the analysis that shows this. Again, this should be included in revising the conceptual model. Does this mean that NDMA was not formed in the DAPL?

3. Page 1-11 Diffuse Layer. *This diffusion results in the presence of a "Diffuse Layer" which is a three to five-foot thick layer of groundwater that overlies the DAPL, and is defined by specific conductance between 20,600 and 3,000 µmhos/cm.*

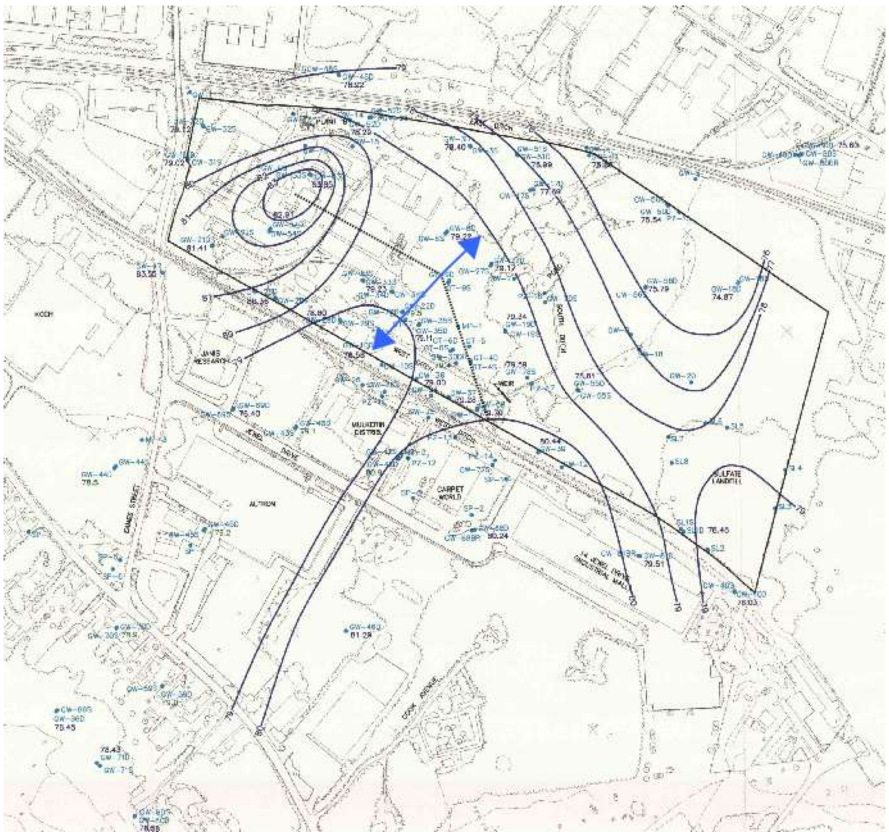
   Comments:

   a. Olin should provide support why 3,000 µmhos/cm was selected as the top of the "Diffuse Layer". Is it arbitrary? Or did it define a concentration in another parameter, SG, SC or other? Vertical profiles of the parameters are needed as noted in comment #1.

   b. Diffusion of NDMA and ammonia, highly mobile parameters, has occurred well beyond 3-5 feet defined by the "diffuse Layer". Olin should clarify in the report that the

Diffuse Layer is limited to selected parameters and doesn't include NDMA and ammonia.

4. Page 1-12 Watershed Divide. Olin states the location of the current watershed divide but fails to recognize (or wishes to ignore) the data which indicates the watershed divide can be on the site when the municipal wells are pumping. The watershed divide being on the site explains why most of the contamination is in the Ipswich watershed and not the Aberjona watershed. The figure below is from Interim Update Investigations, Smith, June 1996.



October 1995

Smith

Additionally, in Olin Wilmington Technical Series XIV. A Groundwater Flow and Solute Transport Model April 2001 by Geomega provided the groundwater information for April 1998.

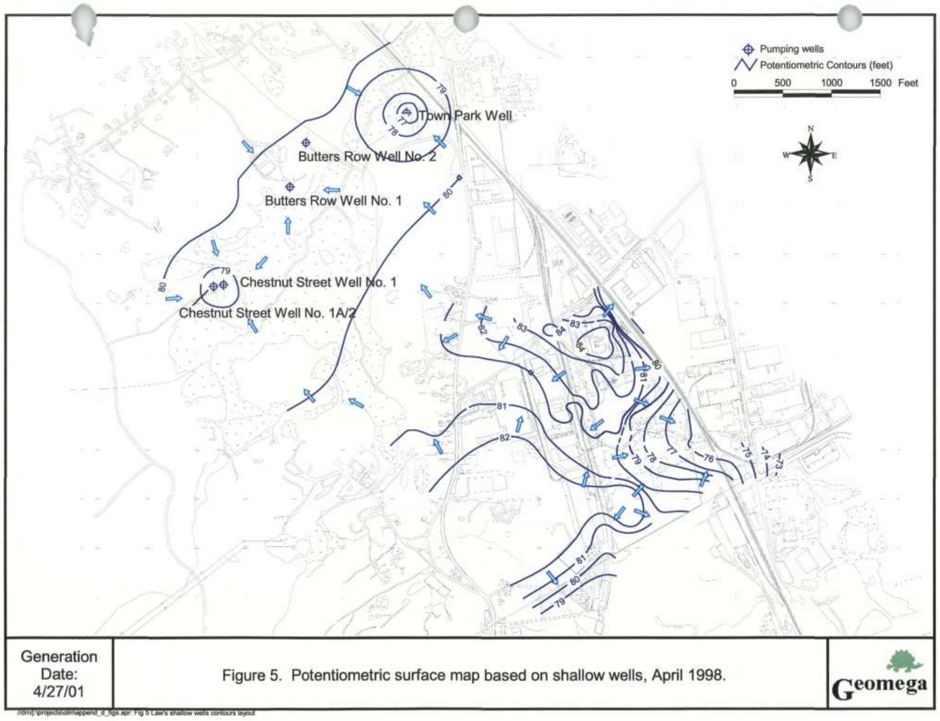


Figure 5. Potentiometric surface map based on shallow wells, April 1998.

5. Page 2-23 Pilot Well. Olin is currently operating the Pilot well at 0.25 gpm, stating operating issues when operating at 0.5 gpm. Please provide the data and other information collected during operation that lead to the conclusion to reduce the operation to 0.25 gpm.

6. Page 2-24 HPIT Olin states:

   The HPIT Final Evaluation report (Amec Foster Wheeler, 2016) that included GeoSierra's Phase II HPIT Report concluded that:

   • A very consistent and stable hydrogeologic condition exists that is dominated by the presence of a vertical hydraulic barrier (e.g., the slurry wall) that diverts groundwater around the Containment Area, and isolates the groundwater within, and

   • That the slurry wall associated with the Containment Area continues to serve its intended purpose and be structurally sound.

   The USEPA accepted Olin's recommendation of no further testing related to the slurry wall.

   <u>These statements are not true.</u> The conclusion from the study was that HPIT could <u>NOT</u> determine the adequacy of the slurry wall. Additionally, page 5 of the HPIT Report

states:

The results of test well pair GW-6D to GW-CA3D deserves additional discussion. We believe the pressure pulse observed between these two wells was transmitted likely under the wall rather than through it.

Olin also states the slurry wall is not keyed into the bedrock. WERC stated our comments on the HPIT Report, using the water surface elevation data collected inside the containment area since 2013, one can show that the outside water surface elevations have a significant influence on the interior water surface elevations. This indicates that flow is occurring into and out of the containment area either through the slurry wall, through the slurry wall/bedrock interface, through weathered bedrock under the slurry wall, or through bedrock fractures. Include this analysis in the revised report.

7. Page 3-16 Hydraulic Changes Since Cessation of Municipal Well Pumping Olin states:

   To provide a direct comparison of hydraulic changes since cessation of pumping (in 2003) from the five Municipal wells located in the MMB aquifer, the groundwater surface observed in 2011 was compared to water level maps prepared by Smith in October 1995 and April-May 1996 and presented in the Phase II Supplemental Investigation Report. The review focused on two key areas – the MMB aquifer area downgradient of the Site, and the groundwater divide area near Jewel Drive and the Olin property.

   -

   *While the 1995 maps do not provide resolution regarding the location of the groundwater divide area near the Site, April/ May 1996 data is helpful as it has more data points. Based on this data the location of the divide is interpreted to fall between the May and October 2011 divides as depicted in **Figure 3.6-1**.*

   It is relevant to note that apparent location of the divide may also be affected by pumping of groundwater from the two Altron wells on the 1 Jewel Drive property.

   Overall, the cessation of pumping from municipal wells had no major impact on the groundwater divide observed near the site.

   WERC disagrees with a number of these statements. Olin discounts the use of the October 1995 groundwater divide because of limited data points. WERC believes the October 1995 water levels are as valid as other data and important to understand why the contamination is in the Ipswich Watershed. Also, the operation of the municipal wells <u>does</u> impact the location of the groundwater divide in the area. Include in analysis the October 1995 and all other available groundwater data, in the determination of potential groundwater divides under future municipal well pumping scenarios.

8. Page 4-4 NDMA Formation. As requested many times, Olin fails to provide any potential formation mechanisms for NDMA. Olin should provide the possible sources of NDMA. Please include in the revised report.

9. Page 4-7 NDMA. A review of Figures 4.4.1-1a/b/c indicates that additional wells are needed east of the site to define the impact boundary.

Figure 4.4.1-1b Deep Overburden Groundwater. The wells along the east side of the site; GW-32D, GW-52D, GW-307, GW-3D, GW-51D, GW-4D, GW-50D and GW-80D all have detects of NDMA which range from 22 to 1300 ng/l of NDMA.

Figure 4.4.1-1c Bedrock Groundwater. Only two bedrock wells are on the east side, GW-413BR and GW-80BR, which have concentrations around 130 and 97 respectively.

The "Extent of Impacts" boundary is drawn along the property line on the east side of the property. But there are no wells on the east side with very low or non-detects of NDMA to indicate that the line is correct or even reasonably. Additional wells are needed further east to determine where is the actual boundary.

Also, for bedrock wells, Figure 4.4.1-1c, the "Extent of Impacts" boundary for NDMA should be extended to include the private wells that have had detects of NDMA. Please revise these figures in the revised report.

10. Page 5-1 Contaminant Sources. Olin states:

    The DAPL pools, which have been studied extensively, are residual sources of contamination, but are not groundwater.

    Olin has failed to prove the DAPL is not groundwater. Unsupported claims are not adequate as a proof. Olin needs to show that the DAPL is the same material that was released from the lagoon system and that the DAPL did not mix with groundwater. Also, that the volume released from the lagoons is approximate of the volume in the DAPL pools and bedrock.

11. Page 5-4 DAPL Pools. Olin states:

    It is believed the bedrock underlying the WBV was initially, and perhaps extensively impacted by DAPL, and now encompasses a broad area of diffuse groundwater with bedrock. This would be consistent with findings of bedrock borings installed around the perimeter of the DAPL pools (GW-202BR, GW-406BR, and MP-4). These wells contain diffuse groundwater, not DAPL, with few exceptions.

    Additional evidence and explanation is required regarding why only the diffuse groundwater and not 'DAPL' has penetrated the bedrock fractures. Please explain in the revised report.

12. Page 5-5 DAPL Chemistry. Olin states:

    The origin of NDMA is not known but precursor studies performed of DAPL and Diffuse Layer material did not indicate it forms in DAPL or diffuse chemical environments.

    So, Olin is claiming that the NDMA did not form in the DAPL or the diffuse layer. If so, please explain where the NDMA is from? Include analysis of NDMA concentration correlated with other compounds such as ammonia, sulfate, hydrazine, formaldehyde, or acetaldehyde; as well as correlations with depth, pH, and other characteristics.

13. Page 5-5 Domestic Gray Water. Is Olin claiming that the NDMA detected in private wells is from onsite septic systems and not from the Olin site? Putting this statement in the report as an attempt to not be responsible for the NDMA in private wells, is very questionable practice. Please provide further information besides one reference paper supporting information. Consider a field program to sample for NDMA from the on-site septic system to support the claim.

14. Page 5-7 Bedrock Fractures Model. Olin has developed a simple ModFlow model of the bedrock and bedrock fractures to examine the migration and removal of NDMA after removal of DAPL. Some questions:

    a. The model didn't represent the actual process of pumping to remove the DAPL over time. Further analysis is required. Does pumping the DAPL work to contain the NDMA in the bedrock fractures.

    b. How much is NDMA is left in the bedrock fractures after removal of the bedrock pools? Is the amount small compared to the volume in the DAPL pool? It is likely that modest continued pumping in the DAPL pools would be able to capture any NDMA diffusing up from the bedrock. Please provide information on amounts.

15. Page 5-8 Migration Route. It is not clear, but it appears Olin is claiming that only dissolved constituents from the DAPL migrate into the bedrock matrix and fractures. Please provide an explanation why DAPL does not migrate into the bedrock fractures.

16. Page 6-1 BHHRA Summary. The private potable wells on Cook Avenue are not included in the analysis.

17. Page 7-2 On Property DAPL pool. Several comments:

    a. Olin states*:*

    The hydraulic conductivity of the slurry wall is less than 1E-8 cm/sec. Based on extensive evaluation, there are no hydraulic indications that the function of the slurry wall is compromised in any way.

    The HPIT failed to determine anything about the hydraulic conductivity of the wall and raised suspicion that the water traveled through bedrock fractures in and around the containment area. Please delete this statement.

    b. Also,

    The on-Property DAPL pool is not considered a source of current impacts to South Ditch.

    Please revise this statement. The on-property DAPL pool is considered a source of impacts to the south ditch.

18. *Page 7-2 Ipswich watershed. Olin states:*

Restoration of fractured bedrock is also believed to be technically impracticable due to the long-time frame NDMA has been in contact with bedrock at high concentrations -and the fate and transport characteristics of NDMA as described and corroborated by the model.

This statement is at best premature in RI report. The simple bedrock fracture model raised more questions and answered very few. Please remove.

19. *Page 7*-3 Olin states:

There is no evidence to indicate NDMA is currently forming in DAPL or diffuse groundwater or has ever done so.

So, NDMA did not form in the DAPL or diffuse groundwater. Olin needs to explain where did the NDMA form*?*

conclusion and the Source Control FS shall develop remedial alternatives for reducing the toxicity to acceptable levels.

3. Section 1.3.3, pages 1-9 to 1-14. This BHHRA has used deed restrictions and the MCP's definitions of drinking water source areas to determine groundwater usage exposure scenarios. Based on this approach, groundwater within the Aberjona River watershed (except for private wells and a 500-foot radius around each of these wells), including the groundwater beneath most of the Olin property, is considered for non-potable uses only (irrigation, vapor intrusion, contact during excavation). The BHHRA includes the 2010 Massachusetts DEP Groundwater Use and Value Determination, which states: "Because a portion of the Site falls within a GW-1 area, (the Zone II to the north) and the close proximity to private drinking water wells to the southeast and the GW-1 potential drinking water source area to the south, and in light of the factors contained in EPA's Final Groundwater Use and Value Determination Guidance, the Department supports a high use and value for the Site area aquifer." Olin presented potable use exposure scenarios for private wells and the Ipswich River watershed aquifers and non-potable uses for the Aberjona River watershed aquifers. This approach is not consistent with the use and value determination made by the state. The BHHRA shall be revised to include an evaluation of the potential for potable water use in the Aberjona River watershed aquifer, using data from monitoring wells in this watershed not just the data from the existing private wells.

4. Page 1-14 of the report states that: "The Mass DEP document recommends that the risk assessment of the site area groundwater should include active and potential drinking water, vapor seepage into buildings, use of water in industrial processes, excavation into groundwater (worker exposure) and discharge to surface water. The BHHRA is including active and potential drinking water as well as vapor intrusion, use of groundwater for non-potable use (irrigation), and the RI/FS for OU1 and OU2 address the risk to surface water associated with groundwater/surface water interaction." The last sentence in this statement shall be deleted as the BHHRA and RI/FS for OU1 and OU2 fail to correctly assess these exposure scenarios. In addition, the revised RI Report and BHHRA shall be revised to include a correct risk assessment for potable use of groundwater in the Aberjona Watershed as directed in the comment above; for possible vapor seepage into current and future buildings; for worker exposure to groundwater used for industrial processes, for use of groundwater for irrigation, for exposure to groundwater during excavation and for exposure to surface water and sediments in the brook.

5. Section 1.5.6.2, Page 1-20 – The BHHRA has eliminated off-property vapor intrusion as a pathway of concern because the only exceedances of VISLs were CVOCs considered not Site-related and petroleum-related chemicals that are either "low" or can be attributed to off-property sources. The BHHRA shall document these non-Site-related, "low," and off-property sources.

6. Section 1.5.6.2, Page 1-20 – As requested by EPA, the BHHRA includes a potential drinking water scenario using data collected from DAPL. However, the document repeatedly argues that this is an improbable scenario because the DAPL is so badly contaminated that no one would use it as a drinking water source (it is green/black in color…). All reference to how improbable the scenario is shall be deleted from the BHHRA.

7. Section 2 - Groundwater data used in BHHRA calculations includes sampling data between 1995 and present. In general, EPA guidance recommends using data from the most recent sampling. The goal is to have at least 10 results to calculate statistically valid 95% UCLs using ProUCL. Data should be limited to more recent data where possible. Monitoring well data included data collected between 2010 and 2017. Many of those wells were sampled most recently during the comprehensive 2010 RI monitoring rounds. However, some wells (for example GW-24, which appears to have been sampled 18 times between 2010 and 2017) have been sampled multiple times. For such monitoring wells, the most recent 1 to 2 rounds of data shall be used unless older rounds are being included to capture the most recent analysis of particular COCs. Private well data included data collected between 1995 and 2017. There are quarterly data going back many years. Data from the last 2-3 years only shall be used to represent current conditions. Town well data included data collected in 2003 and earlier. Because there is no more recent data, the use of this older data from the town wells for COPC selection purposes is acceptable. Data from the former Sanmina property were collected in 1997 through 2004. Because there is no more recent data, the use of older data from the Sanmina wells is acceptable; however, limit that data to the two most recent years (2003 and 2004).

8. Section 2.3, Page 2-17 – The BHHRA assumed that detections of hexavalent chromium in groundwater were false positives. Therefore, the RSL for chromium was used to evaluate total chromium analytical data. Hexavalent chromium was detected in some shallow overburden wells off-property and consistently detected in bedrock in the southwest portion of the Site and therefore shall not be eliminated from consideration in the risk assessment. The BHHRA shall be revised accordingly.

9. Section 3.2.1, page 3-4 – The BHHRA states that EPCs have been calculated for each of the residential wells where NDMA was detected. There are private wells where NDMA was not detected, but other potentially site related contaminants (chloride, sulfate, nitrogen as ammonia) were. EPA acknowledges that, as discussed in the uncertainty section, there are no currently available EPA tapwater regional screening levels (RSLs) for these contaminants, no applicable toxicity values, and consequently no risks calculated. The BHHRA shall include an explanation (perhaps including this information and referral to the uncertainty section) of why EPCs and risks were not calculated for these private wells.

10. Section 3.2.1, pages 3-4 and 3-5 – Groundwater data collected from monitoring wells from the core of the plume(s) were used in calculating EPCs for the Ipswich River watershed and Aberjona River watershed overburden and bedrock. The text indicates locations of selected wells from the core of the Ipswich River watershed are shown on Figures 2.1-1 and 2.1-2. The text indicates locations of selected wells from the core of the Aberjona River watershed are shown on Figures 2.1-4 and 2.1-5. These wells shall be highlighted and encircled on the figures. The BHHRA shall clarify the criterion used to identify which wells were selected as representative of the core of the plumes.
    a. Ipswich River Overburden – GW-84D, GW-85D, GW-86D, and GW-87D
    b. Ipswich River Bedrock – GW-103BR, GW-61BR, GW-62BR, GW-62BRD, GW-62BRDD, GW-62BRDS, and MP-5#03
    c. Aberjona River Overburden – GW-10DR, GW-55D, GW-69D, GW-202D, GW-307, MP-1#07, MP-1#08, MP-1#14, MP-2#06, and MP-2#07

d. Aberjona River Bedrock – GW-202BRD, GW-202BRS, GW-406BRD, and GW-406BRS

11. Section 3.2.2, pages 3-5 and 3-6 – Shower EPCs - To calculate inhalation exposures for residential potable water use, the BHHRA is using a showering model (Foster & Chrostowski, 1987) used by MassDEP in developing their MCP-GW-1 standards; rather than using the inhalation of vapors during household water use model (Andelman, 1990) currently used in developing the inhalation portion of the EPA tapwater RSLs. Both models have been used in HHRAs over the last 20+ years. The advantage of the Andelman model is its simplicity, but also that it covers exposures to volatiles from all household water uses (showering and bathing, but also laundry, cooking, dishwashing, etc.). The Foster & Chrostowski model is strictly a model for exposures while showering. By using the Foster & Chrostowski model, the BHHRA does not include a 24 hr/day exposure to household air created by a variety of household water uses, but rather only evaluates inhalation exposures for the few minutes a day while showering. The uncertainty section (Section 6.2.2.1) discusses these two models and the justification for selecting the shower model. The BHHRA shall also present, in the uncertainty section, risks using the Andelman model with an adjusted volatilization constant K at the low end of Andelman's range as a counterpoint to the shower model.

12. Section 3.3.1, page 3-8 and Table 3.1-1 - Exposure Assumptions - Because of the selection of the Foster & Chrostowski model, inhalation exposure times are limited to time spent in the bathroom during showering (EPA default showering/bathing time is 43 minutes (0.7 hr) for adults and 32 minutes (0.54 hr) for children), as opposed to 24 hr/day exposure to household air. In addition, the BHHRA assumes the shower is only running for 1/2 that time and so uses 1/2 the EPA recommended default showering exposure times within the model to develop the air concentration. Exposure times are still shown on Table 3.1-1 as the default values; however, it is within the calculation of the air concentration that this reduction in time has been carried out ("time in shower" on Table 3.1-1). Although this may be appropriate for a CTE evaluation, the model shall use the full default exposure time to calculate the indoor air EPC while showering for an RME evaluation.

13. Section 5.1.3, page 5-3 - The text states: "Risks at or below 10^{-4} (upper end of the NCP risk range) do not generally warrant a response action. Risks greater than 10^{-4} generally warrant development and evaluation of remedial alternatives." (citation omitted). This text shall be replaced with the following statement consistent with EPA policy: "CERCLA requires regulatory risk management review within a targeted cancer risk range of 1E-06 to 1E-04. Risks below 1E-06 (less than 1 in 1 million) are generally considered to be acceptable by EPA. Risks greater than 1E-04 (1 in 10,000) are generally considered to be unacceptable."

14. Section 5.2.2.6, pages 5-9 and 5-12 – On-property construction workers are exposed to contamination in both groundwater and soils. The BHRRA shall include cumulative risks for construction workers exposed to both these media. Risks for soils were calculated under OU1. Those calculated risks shall be brought forward and the BHRRA shall present total cumulative risks for these receptors.

15. Section 5.2.3.2, pages 5-11 and 5-12 – EPA's current goal for lead evaluations is that no more than 5% of individuals exceed the target blood lead level of 5 μg/dL. The BHHRA shall

provide the percent of exposed children with estimated blood lead levels exceeding the target level of 5 µg/dL.